# Volume 1

# Final
# Corrective Action
# Implementation Work Plan
# Building 207/231 Area
# Presidio of San Francisco, California

Prepared for

**The Presidio Trust**
67 Martinez Street, P.O. Box 29052
San Francisco, California 94129-0052

MACTEC Project No. 4084075106 07


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October 23, 2008


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This document was prepared by MACTEC Engineering and Consulting, Inc. (MACTEC) at the direction of the Presidio Trust (Trust) for the sole use of the Trust, the National Park Service (NPS), and regulatory agencies, the only intended beneficiaries of this work. No other party should rely on the information contained herein without the prior written consent of the Trust. This report and the interpretations, conclusions, and recommendations contained within are based, in part, on information presented in other documents that are cited in the text and listed in the references. Therefore, this report is subject to the limitations and qualifications presented in the referenced documents.

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## ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| 1,2-DCA | 1,2-dichloroethane |
| 1,2-DCB | 1,2-dichlorobromine |
| AC | asphalt concrete |
| ACMs | asbestos containing materials |
| Army | United States Department of the Army |
| ASC | Anthropological Studies Center |
| BAAQMD | Bay Area Air Quality Management District |
| bgs | below ground surface |
| BMPs | best management practices |
| BTEX | benzene, toluene, ethylbenzene, xylenes |
| Cal OSHA | California Occupational Safety and Health Administration |
| Caltrans | California Department of Transportation |
| CAP | Corrective Action Plan |
| CCR | California Code of Regulations |
| Cleanup Level Document | Development of Presidio-wide Cleanup Levels for Soil, Sediment, Groundwater and Surface Water |
| COC | chemical of concern |
| Construction Documents | Construction Drawings and Technical Specifications |
| Contractor | Excavation Contractor |
| County | County of San Francisco Department of Environmental Health |
| CQA | Construction Quality Assurance |
| cy | cubic yards |
| °C | degree Celsius |
| DO | dissolved oxygen |
| DOT | Department of Transportation |
| DPT | direct push technology |
| DTSC | Department of Toxic Substances Control |
| Dup | duplicate sample |
| EDD | electronic data deliverable |
| EKI | Erler and Kalinowski, Inc. |
| EMP | Erosion Monitoring Plan |
| Engineer | Design Engineer |
| EPA | Environmental Protection Agency |
| ESL | environmental screening level |
| FDS | fuel distribution system |
| FPALDR | Fuel Product Action Line Level Development Report |
| GGNRA | Golden Gate National Recreation Area |
| GIS | Geographical Information System |
| GSA | General Services Agency |
| HASP | Health and Safety Plan |
| HAZWOPER | Hazardous Waste Operations and Emergency Response |
| IDW | Investigation-derived waste |
| LTTD | low temperature thermal desorption |
| LUC | land use control |
| LUCMRR | Land Use Control Master Reference Report |
| MACTEC | MACTEC Engineering and Consulting, Inc. |
| MCLs | maximum contaminant limits |

| | |
|---|---|
| MeCl | bromobenzene, methylene chloride |
| mg/kg | milligrams per kilogram |
| mg/L | milligrams per liter |
| MS/MSD | Matrix Spike/Matrix Spike Duplicate |
| MTBE | methyl tertiary butyl ether |
| N squared | NEPA and NHPA single review |
| NEPA | National Environmental Policy Act |
| NHL | National Historic Landmark |
| NHPA | National Historic Preservation Act |
| NOT | Notice of Termination |
| NPS | National Park Service |
| OCP | organochlorine pesticides |
| ORC Advanced™ | Regenesis, Inc.'s Oxygen Release Compound Advanced ™ |
| OVM | organic vapor measurement |
| PAHs | polynuclear aromatic hydrocarbons |
| PCBs | polychlorinated biphenyls |
| PCC | Portland cement concrete |
| PCE | tetrachloroethene |
| Phase I IA | Phase I Interim Action |
| PID | Photo-ionization detector |
| PLLW | Presidio lower-low water |
| POTW | Publicly Owned Treatment Works |
| Presidio | Presidio of San Francisco, California |
| PTMP | Presidio Trust Management Plan |
| PVC | polyvinyl chloride |
| QA/QC | quality assurance/quality control |
| QAPP | Quality Assurance Project Plan |
| RAB | Presidio Restoration Advisory Board |
| RAOs | Remedial Action Objectives |
| RB | Rinsate blank |
| Redox | reduction-oxidation |
| RegenOx™ | Regenesis, Inc.'s Chemical Oxidation Compound |
| RFI | Requests for Information |
| ROI | radius of influence |
| RU | remedial unit |
| SAP | Sampling and Analysis Plan for Corrective Actions |
| SF Coroner | San Francisco Coroner's Office |
| sf | square feet |
| SOP | Standard Operating Procedure |
| the Site | Building 207/231 Area, Presidio of San Francisco, California |
| SSHP | Site Safety and Health Plan |
| SWPPP | Storm Water Pollution Prevention Plan |
| TB | trip blank |
| T&R | Treadwell & Rollo, Inc. |
| TCE | trichloroethene |
| TCLP | toxicity characteristic leaching procedure |
| TDS | total dissolved solids |
| TPH | total petroleum hydrocarbon |
| TPHd | total petroleum hydrocarbon as diesel |
| TPHfo | total petroleum hydrocarbon as fuel oil |

| | |
|---|---|
| TPHg | total petroleum hydrocarbon as gasoline |
| the Trust | Presidio Trust |
| µg/kg | micrograms per kilogram |
| µg/L | micrograms per liter |
| USA | Underground Services Alert |
| USEPA | United States Environmental Protection Agency |
| USTs | underground storage tanks |
| UXO | unexploded ordnance |
| VC | vinyl chloride |
| VOCs | volatile organic compounds |
| Water Board | Regional Water Quality Control Board |
| Water Board Order | Water Board Order No. R2-2003-0080 |
| Work Plan | Corrective Action Implementation Work Plan |

# EXECUTIVE SUMMARY

On behalf of the Presidio Trust (Trust), MACTEC Engineering and Consulting, Inc. (MACTEC) prepared this Corrective Action Implementation Work Plan (Work Plan) to implement the corrective actions at five remedial units (RUs) proposed in the *Building 207/231 Area Final Corrective Action Plan, Building 207/231 Area, San Francisco, California* (CAP) and as amended in the *Addendum to the Final Corrective Action Plan, Building 207/231 Area, San Francisco, California* (CAP Addendum). The Building 207/231 Area (Site) comprises approximately 8 acres of land in the northeast portion of the Presidio of San Francisco, located south of the Crissy Marsh. Doyle Drive/Highway 101 north- and south-bound overpasses bisect the Site.

The purpose of the corrective actions are to achieve "clean closure" for unrestricted reuse of the Site. This Executive Summary provides a summary of site background and RUs identified in the CAP, and summarizes the Work Plan's general and RU-specific corrective action activities.

### *Background*

The Site is within the Presidio of San Francisco National Historic Landmark District. Historic resources designated for preservation include Building 228 and historic walls south and southwest of Building 231. Potential planned uses of the Building 207/231 Area include onsite restoration of the Quartermaster's Reach of the adjacent Crissy Marsh and freshwater Tennessee Hollow Riparian Corridor adjacent to a historic wall in the southern portion of the Site, replacement of the Doyle Drive/Highway 101 overpasses, and continued use of existing buildings by tenants and preservation of historic structures. Cleanup levels for soil and groundwater were identified using the most stringent (lowest) of up to four different scenarios assuming human and ecological receptors that may be present at the Site during reuse.

Five different soil RUs and four co-located groundwater RUs require cleanup due to the presence above cleanup levels of total petroleum hydrocarbons (TPH) as gasoline, diesel, and/or fuel oil; volatile organic compounds (VOCs), and less-extensive occurrences of polynuclear aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), pesticides, and metals.

### *Corrective Actions*

*Corrective Actions for Southern Portion of Site at Historic Wall Interface*: The approved corrective actions for the southern portion of the Site were selected based on an intent to preserve the historic wall and several historic buildings in this area. The corrective action was selected because residual

contamination is present between the historic building and wall. On both sides of the historic wall at this interface where excavation can not be performed directly adjacent to the wall or buildings without endangering their structural integrity, subsurface petroleum contamination will be addressed through in situ remediation, groundwater monitoring, and a land use control (LUC). For the portion of the Building 231 RU that occurs just north of the historic wall interface where excavation can not be implemented without endangering the structural integrity of the historic wall, in situ remediation consists of in situ injection of a chemical oxidant, followed by in situ injection of an oxygen releasing compound to stimulate biodegradation of residual petroleum hydrocarbons in the saturated zone of the subsurface. The approved corrective action for the Building 228 RU that occurs just south of the historic wall interface consists of in situ injection of an oxygen releasing compound to stimulate biodegradation of residual petroleum hydrocarbons in the saturated zone of the subsurface in the northern portion of the RU.

In the remaining portions of the Building 228 RU, the approved corrective action consists of inspection of the outdoor cap (paved areas) in the northern and southern portions of the RU, and improvements and maintenance, as necessary. Inside Building 228, the indoor cap of the building will be inspected, and vapor intrusion to indoor air within Building 228 will be assessed through collection of soil gas samples. Soil gas sampling will be followed by indoor air monitoring for any chemicals reported in the soil gas samples if potentially significant risks to future building occupants are identified. The corrective action for the Building 228 RU also includes groundwater monitoring and a LUC.

The corrective actions at the historic wall interface address a portion of the Building 231 RU and two separate portions of the Building 228 RU. These corrective actions are planned to occur in advance of the excavation activities:

- <u>Southern Portion of the Building 231 RU</u>—An area adjacent to the historic wall just south of Building 231 where equipment associated with the former service station complex was stored.

- <u>Northern Portion of the Building 228 RU</u>—Existing Building 228 that contained a former dry cleaning facility and the area north of the building that contained former Stoddard solvent and heating oil underground storage tanks (USTs) adjacent to a historic wall; and

- <u>Southern Portion of the Building 228 RU</u>—An area adjacent to the southeastern corner of Building 228 where a former fuel distribution system (FDS) line was located.

<u>*Corrective Actions for Northern and Central Portions of Site*</u>: The approved corrective action for the four RUs that occur in the northern and central portions of the Site consists of removing contaminated

fill—the source of contamination to groundwater—to achieve clean closure for unrestricted reuse. This will be achieved through excavation and offsite disposal of contaminated soils and backfill with natural sands, followed by downgradient groundwater monitoring to confirm source removal has reduced impacts to groundwater for the following RUs:

- Former Building 207 fueling station and adjacent Former Building 208 sump in the northern portion of the Site (Former Building 207 RU);
- Former Buildings 38, 38-A, and garage oil station in the northeastern portion of the Site (Former Building 38 RU);
- Existing Building 231 and former service station complex in the central part of the Site (Building 231 RU), including a small adjacent area associated with the Former Building 271 garage; and
- Existing Building 230 adjacent to a former railroad spur loading dock in the eastern portion of the Site (Building 230 RU) – no groundwater RU has been identified.

*Implementation Team*: Ryan Seelbach of the Trust will be the Remedial Project Manager responsible for implementation of the approved corrective actions. Construction Drawings and Technical Specifications (Construction Documents) accompanying this Work Plan provide additional detail regarding requirements of the Excavation Contractor (Contractor) for the excavation component of the corrective actions. The Trust will manage and implement other components of the corrective actions not related to excavation under separate contracts.

MACTEC will serve as the Trust's Construction Manager and Design Engineer, overseeing and directing all site contractors (including archaeologists) and serving as Site point-of-contact for Site visitors. MACTEC will collect confirmation samples and evaluate results, and will prepare the construction completion report that certifies construction quality assurance. MACTEC will also be responsible for outdoor cap inspection, in situ remediation and effectiveness monitoring at the historic wall interface for portions of the Building 231 and Building 228 RUs that will not undergo excavation, as well as in-situ confirmation sampling at the historic wall interface within the Building 228 and 231 RUs where in situ remediation will be performed; HydroPunch sampling at the Building 230 RU; and report preparation for implementation of LUCs. A subcontractor to MACTEC will provide archaeological monitoring during excavation activities.

Treadwell & Rollo (T&R) will abandon and install wells and perform groundwater monitoring. Erler and Kalinowski, Inc. (EKI) will perform indoor cap inspection and soil gas sampling at the Building 228 RU. Soil gas sampling will be followed by indoor air monitoring for any chemicals reported in the soil gas assessment if potentially significant risks to future building occupants are identified. The Excavation Contractor (Contractor) who will perform excavation will be selected through competitive bidding.

***Pre-Construction Activities***

The pre-excavation activities that are anticipated to be initiated and/or conducted consist of the following general sequence of activities that may be adapted during the contracting phase of the project:

*Pre-Construction Groundwater Monitoring*: T&R performed one round of groundwater monitoring on 11 existing wells/piezometers (selected due to prior detections of arsenic) to assess petroleum-related chemical of concerns (COCs), arsenic, other RU-specific COCs, and associated reduction-oxidation (redox) parameters (pH, dissolved oxygen [DO], dissolved manganese, dissolved iron, dissolved aluminum) to establish baseline conditions for COCs and redox parameters prior to remediation. Two rounds of sampling were also conducted for the well pair, 231GW200A/200B, installed at the historic wall interface downgradient of the oxygen release compound treatment area at the Building 228 RU for the analytes and parameters noted above.

*Building Demolition*: Prior to initiation of field remediation activities described in this Work Plan, the Trust will demolish Building 231 and remove the existing above-ground soil vapor extraction system equipment located to the southeast of Building 231. The demolition is planned to be implemented prior to initiating in situ remediation at the historic wall interface or the indoor air and cap assessment at the Building 228 RU, in order to provide better access for drill rigs and sampling equipment in these areas that currently have limited access due to the presence of Building 231 and associated above-ground structures.

*Building 228 Indoor Air and Cap Assessment*: Prior to initiation of construction activities, EKI will assess potential vapor intrusion to indoor air and inspect the indoor cap and building foundation. Soil gas sampling will be followed by indoor air monitoring for any chemicals reported in the soil gas samples if potentially significant risks to future building occupants are identified. Following completion of the indoor air assessment, EKI will recommend and oversee any indoor mitigation measures such as sealing the flooring and any conduits to the subsurface.

*Historic Wall Interface Corrective Action Implementation*: Prior to initiating construction activities, MACTEC will implement in situ remediation at the historic wall interface within portions of the Building 231 and 228 RUs described above. In situ treatment will be implemented to enhance biodegradation of residual petroleum contamination in the saturated subsurface and mitigate potential downgradient recontamination of the other RUs. The in situ remediation compounds that will be injected into the subsurface are expected to begin releasing oxygen immediately upon introduction into the subsurface, and continue to release oxygen for a period of approximately 18 months. MACTEC will also inspect the adjacent outdoor paved areas in the northern and southern portions of the RU, and will recommend and oversee outdoor cap improvements such as repaving.

In January 2008, T&R installed a monitoring well pair just downgradient of the Building 228 RU and historic wall within the portion of the Building 231 RU that will also be treated by in situ injection (231 GW200A/200B). Groundwater samples were collected from the newly installed wells to serve as a baseline to evaluate the effectiveness of in situ treatment at these RUs in the future, and to provide data for consideration in the in situ remediation approach for the historic wall interface. This well pair was sampled during the first and second Quarters 2008 under the Presidio-wide groundwater monitoring program.

The new downgradient monitoring well pair that will be used to monitor the effectiveness of in situ remediation in enhancing petroleum degradation at the historic wall interface will also be sampled for biodegradation indicator parameters and COCs to evaluate if oxygen concentrations increase or if biodegradation bi-products are present. These indicator parameters will identify if the locally reducing environment has been (temporarily) changed into an oxidizing environment and if aerobic biodegradation is taking place.

***Preparation for Excavation Construction Activities***

The following pre-construction activities are anticipated during implementation of the corrective actions for the Site.

*Sampling of Low Temperature Thermal Desorption (LTTD)-Treated Backfill Materials*: Prior to excavation construction activities, MACTEC will collect a minimum of three soil samples from within the footprint of the LTTD-treated backfill within the Building 207 RU to verify whether concentrations of COCs in the backfill materials exceed cleanup levels and require excavation. The results will be made available to the Water Board and stakeholders.

Potential Documentation of Revised Cleanup Levels for Metals in Soil: Excavation will be performed in areas where petroleum contaminated soils are present above cleanup levels, as well as other areas containing co-located petroleum-related COCs and metals contamination. However, although plans are provided herein for excavation of metals in soil at concentrations that exceed available background threshold levels, confirmation sampling data for non-petroleum-related COCs and metals contamination that may be indicative of background conditions will be assessed. The Trust, in consultation with the Water Board, will assess if concentrations of metals in native soils at the Site are indicative of site contamination or naturally occurring background conditions. The methodology will incorporate confirmation sampling data collected as part of the remediation program, to assist in the assessment of the distribution of metals in soil and decisions regarding excavation.

Well Abandonment: Prior to construction, Treadwell & Rollo (T&R) will abandon 40 existing groundwater monitoring wells (within the Building 207/231 CAP Area that are not included in the CAP Groundwater Monitoring Program), and seven existing groundwater monitoring wells (within the Building 207/231 CAP Area that are included only in the CAP Pre-Construction Groundwater Monitoring Program).

***Site Preparation and Construction Activities***

The Contractor will set up temporary facilities such as fencing, signs, soil stockpile, and truck staging areas at the Site, and will decommission utilities (i.e., water, sewer lines, gas lines, and a 20-inch storm drain line) traversing through the excavation and as necessary, and temporarily reroute utilities around the Site. The Contractor will install a temporary sewer connection to reroute the sanitary sewer line around the project site to the south to the Edie Road trunk line. The Contractor will remove asphalt concrete (AC) pavement within the planned excavation areas of the soil RUs, and will clear and grub vegetation from other areas as necessary.

Building 230 RU: Prior to initiation of corrective action, the Contractor will remove the water service from Gorgas Avenue (located within the 230 RU), which traverses through the excavation and provide potable water service to Building 230 by extending the water line from the south.

The Contractor will excavate soil in the vadose zone up to 5.5 feet below ground surface (bgs) adjacent to and just east of the building (COCs exceed cleanup levels between 3 and 5.5 feet bgs). The edge of the excavation parallel with the east side of Building 230 will be constructed adjacent to the loading dock on

the building's east side. Following completion of excavation, the Contractor will reinstall the water service from Gorgas Avenue, backfill and repave the excavation.

Groundwater was not sampled in this area; however, saturated soils were sampled at intervals of 7.5 and 10 feet bgs, and no COCs were detected above cleanup levels within saturated soil samples. Therefore, this is the only soil RU at the Site that is not co-located with an identified Groundwater RU. MACTEC will collect two HydroPunch groundwater confirmation samples from the intermediate sand layer, located underneath the Bay Mud from within the Soil RU excavation after soil has been removed to assess groundwater impacts at this RU; the collected groundwater samples will be analyzed for the RU-specific COCs identified for the Soil RU, arsenic, and associated redox parameters.

*Building 38 RU*: Soil contamination above COCs is present in unsaturated and saturated zone soils, and is believed to extend under the north Doyle Drive overpass structure. The Contractor will excavate soil to the south and the north of the northern Doyle Drive overpass. Contaminated soil will be left in place where excavation cannot continue under the Doyle Drive overpass structures; a LUC will be implemented for this portion of the RU until it is excavated during the eventual Doyle Drive replacement project construction. This RU will be completely backfilled and repaved to the south and seeded with Dwarf Tall Fescue seed to the north of the northern Doyle overpass to match existing conditions.

*Building 207 RU*: The Contractor will excavate soil impacted with COCs above cleanup levels. Contaminated soil will be left in place where excavation cannot continue under the Doyle Drive overpass structures (a LUC will be implemented for this portion of the RU until it is excavated during the eventual Doyle Drive replacement project construction). This RU will be completely backfilled and seeded with Dwarf Tall Fescue seed to the north of the northern Doyle overpass to match existing conditions.

*Building 231 RU*: Prior to excavating the Building 231 RU, the Contractor will remove the water line providing fire water service to Building 230 (from west side of the building); the Contractor will provide fire water service using the line installed along the east side of Building 230.

The Contractor will excavate soil impacted with COCs above cleanup levels. During excavation, the Contractor will remove underground SVE system piping and other decommissioned utilities (i.e., sewer, water, gas, 20-inch storm drain line). This RU will be backfilled and repaved after excavation and confirmation sampling is completed.

Contaminated soil will remain in place where excavation cannot continue under and adjacent to the southern Doyle Drive overpass structure until it can be accessed for excavation during the eventual Doyle

Drive replacement project construction by the California Department of Transportation (Caltrans). Although plans are included herein for excavation of the section of Gorgas Avenue, the Trust plans to initiate consultation with Caltrans regarding deferral of excavation under Gorgas Avenue until the eventual Doyle Drive replacement project construction. A LUC will be implemented for the portions of the RU where the corrective actions are deferred until excavation is performed during the eventual Doyle Drive replacement project construction, including impacted soil in the Former Building 271 RU.

At the southern boundary of the Building 231 RU that abuts the historic wall, excavation will commence with a setback of 5 feet from the wall to protect the structural integrity of this historic resource. To the extent practicable, excavation with hand equipment (e.g., shovels and/or with a small backhoe) will be performed as necessary adjacent to the 5-foot setback to remove impacted soils. Residual contamination in soil above cleanup levels that is within the setback area and cannot be excavated, will be remediated via in situ treatment. The Trust will implement a LUC for this area. A licensed land surveyor subcontracted by MACTEC will survey the areal extent of the LUC for depiction on a topographic site map, which will be included in a site-specific addendum to the Trust's Land Use Controls Master Reference Report.

The Trust, NPS, and their resource groups will restore a portion of the Building 231 RU in a manner that would visually serve to acclimate the public to the appearance of a restored below-grade wetlands. Therefore, the Building 231 RU, except for the Gorgas Avenue section, will be partially backfilled and rough graded to provide a suitable planting area for willows or a similar type of plant.

The partial backfilling will be conducted to minimize the surface expression of shallow groundwater, and will be graded with minimal slope (approximately 0.5 percent) to facilitate maximum storm water infiltration through the sand backfill material, minimize erosion, and provide a suitable surface for the Trust to implement their post-construction site use as a Propagule Planting Area. Drainage will be provided through the installation of a drain inlet and a storm drain pipe that discharges groundwater that may rise above the final grade. However, prior to discharging groundwater to the storm drain, MACTEC will collect one surface water sample (if and when surface expression of groundwater is observed) and test the sample for the RU-specific COCs; the sample will be collected using a bailer in accordance with Trust standard operating procedures. If COC concentrations are above the surface water criteria established for the Site, then the RU will be backfilled to historic high groundwater elevations in the area. Furthermore, until the decision of whether or not the surface expression of groundwater can be discharged

to the storm drain is made, the drain inlet will be raised to the historic high groundwater elevation to prevent discharge into the storm drain system.

If the section of Gorgas Avenue within the RU is excavated during the eventual Doyle Drive replacement project construction, it will be restored in accordance with future restoration plans for that area designed to meet cultural and historic requirements. If the section of Gorgas Avenue within the RU is excavated during planned corrective actions, it will be replaced under plans herein to meet National Historic Preservation Act (NHPA) requirements with a two-way road, a concrete curb, and raised pedestrian trail after excavation activities are completed.

*Groundwater*: The approved corrective actions for the five Soil RUs are anticipated to result in eventual reduction of concentrations of COCs in groundwater to levels that are below cleanup levels at the Site. The Trust will implement a LUC for groundwater at the Site that will be discontinued when post-construction groundwater monitoring indicates corrective actions have reduced concentrations of petroleum-related COCs and arsenic below cleanup levels for four consecutive sampling events. Based on the criteria identified in the CAP, monitoring will be discontinued (subject to Regional Water Quality Control Board [Water Board] approval), the groundwater LUC will be removed, and clean closure with regard to groundwater contamination will be documented in a Site closure report. Wells will be abandoned, as applicable, upon regulatory approval. In accordance with Task 13 of Water Board Order R2-2003-0080, a Five-Year Status Report will be completed and submitted to the Water Board for approval.

*Soil Confirmation Sampling and Over-Excavations*: MACTEC will collect soil confirmation samples within the excavations and compare concentrations against cleanup levels. If confirmation sampling in excavations indicates cleanup levels have not been met, over-excavation and confirmation sampling will be performed. The presence of physical features in portions of the Site or adjacent remediation sites will limit the lateral extent of over-excavation as follows:

- The Building 230 RU excavations will proceed laterally to remove petroleum-contaminated soil, but will be terminated if significant petroleum contamination is no longer encountered and any remaining contamination appears to be fill material associated with Fill Site 6B.

- Excavations are not anticipated to proceed underneath Halleck, Mason, or Marshall Streets. If sidewall soil confirmation samples indicate that significant petroleum-contaminated soil with COCs above cleanup levels extends underneath the roadways, the Trust will confer with the

Water Board to determine if excavation underneath a roadway is warranted. Excavations will not proceed under roadways based solely on soil confirmation samples with metals, PAHs, and other non-petroleum COCs above cleanup levels in excavation sidewalls.

- Excavations will not proceed underneath the Doyle Drive overpasses. A minimum setback of 1 foot to the Doyle Drive overpasses will be maintained so that excavations do not proceed within the right-of-way or beneath the overpass structures. To the extent that excavation under Gorgas Avenue can be deferred until the Doyle Drive reconstruction project, excavation will be delayed until Caltrans removes the overpass structures. The excavations between the Southern and Northern Doyle Drive overpasses will proceed laterally to remove petroleum-contaminated soil, but will be terminated if significant petroleum contamination is no longer encountered. Any remaining soil with chemicals of concern (e.g., metals and PAHs) above cleanup levels between and underneath the Doyle Drive overpass structures will be addressed by a LUC until Caltrans removes the overpass structures and contaminated soil beneath it is removed during the planned Doyle Drive reconstruction project.

- A setback distance of 3 feet to the Building 230 foundation will be maintained to protect its structural integrity. If confirmation sampling indicates any remaining soil with chemicals above cleanup levels adjacent to the building foundation, the Trust will implement a LUC until Building 230 is demolished and contaminated soil beneath the building is removed.

- A setback distance of 5 feet to the historic walls south and west of Building 231 will be maintained; to the extent practicable, excavation with hand equipment (e.g., shovels or with a small backhoe) will be performed adjacent to the 5-foot setback as necessary to remove impacted soils. If confirmation sampling indicates any soil with chemicals of concern above cleanup levels remains adjacent to the historic wall, it will be addressed by a combination of either additional in situ treatment as described above, and/or capping of impacted soils under the LUC for the adjacent Building 228 RU. Any remaining soil with chemicals above cleanup levels adjacent to the wall west of the RU will be addressed by the Fill Site 6B remedy.

- If excavations are terminated before cleanup levels are met, the Contractor will install a visual subsurface marker (such as a permeable geotextile material) to identify the extent of the excavation. Additionally, a licensed land surveyor subcontracted by the Contractor will survey the toe of the excavation limits (to be used to delineate LUCs). If excavation and confirmation sampling at the bottom of the smear zone interface of any petroleum hydrocarbon contamination

indicates concentrations of COCs in samples exceed cleanup levels, the Trust will consult with the Water Board on the approach for addressing residual contamination present below the smear zone.

***Post-Construction Activities***

- The Contractor will remove the temporary sewer connection transferring the sewage to the Edie Road trunk line and install a new 16-inch sewer line through the 231 RU to match pre-excavation sewage infrastructure in the area.

- T&R will conduct ongoing groundwater monitoring of eleven wells (four existing wells, five new replacement wells that will be installed, and the recently installed well pair 231GW200A/200B) to verify (1) chemical concentrations are decreasing after corrective actions are implemented, (2) chemicals in groundwater are not migrating offsite; and (3) and to assess the effectiveness of in situ injection of oxygen releasing compound at the Building 228 RU;

- MACTEC will perform erosion control monitoring of surface erosion control measures (e.g., erosion control fabric, loose straw mulch, straw wattles, etc.) placed on unpaved backfilled areas (i.e., the 231 RU, the 38 RU and the 207 RU to the north of the north Doyle Drive overpass);

- The Presidio Trust will plant willows or similar vegetation in the partially backfilled Building 231 RU;

- MACTEC, on behalf of the Trust, will file a notice of termination (NOT) under the General Permit after construction has been completed and post-construction erosion control measures have been installed;

- Two years after oxygen release compound injection has been performed, MACTEC will conduct direct push soil confirmation sampling within and outside the Building 228 RU footprint to assess the effectiveness of the injection in reducing soil and groundwater COCs below cleanup levels;

- MACTEC, on behalf of the Trust, will prepare a site-specific LUC Addendum to the LUC Master Reference Report (LUCMRR) for areas of residual contamination. All LUC areas will be surveyed in the field and will be depicted on a map. LUCs for the site are anticipated as follows: (a) a temporary LUC for soil beneath structures that will be lifted when clean closure is achieved after future site activities remove these structures to access and excavate contaminated soils

during the eventual Doyle Drive replacement project construction; (b) a LUC for areas where in situ remediation will be conducted that may be lifted if concentration of COCs are reduced below cleanup levels over time; and (c) a LUC for groundwater that will be lifted when clean closure is achieved after cleanup levels have been met under the post-construction groundwater monitoring program. The Trust will perform a review of protectiveness of LUC corrective actions every five years and prepare a Five-Year LUC Review Report with recommendations.

*Reporting*: Upon completion of the corrective actions described in this Work Plan, MACTEC will prepare a Construction Completion Report that presents a summary of the corrective action implementation and results and certifies clean closure with respect to construction quality assurance. The report will also present LUCs and their implementation.

The Trust will also prepare and submit a Five-Year Status Report to the Water Board five years after completion of corrective action completion (the first report is anticipated to be submitted in 2013) that summarizes the status of the corrective action at the Site with respect to groundwater.

# 1.0 INTRODUCTION

MACTEC Engineering and Consulting, Inc. (MACTEC) prepared this Corrective Action Implementation Work Plan (Work Plan) for the Building 207/231 on behalf of the Presidio Trust (Trust) to describe implementation of the corrective actions identified in the *Final Corrective Action Plan Building 207/231 Area, Presidio of San Francisco, California* (CAP; *MACTEC, 2007*) and as amended in the *Addendum to the Final Corrective Action Plan, Building 207/231 Area, San Francisco, California* (CAP Addendum; *MACTEC, 2008b*).at the Building 207/231 Area, Presidio of San Francisco, California (the Site).

As described in the CAP, the purpose of the corrective actions is to achieve "clean closure" for unrestricted re-use of the Site. The purpose of this Work Plan is to describe the plans for conducting work to implement the approved corrective actions for the five remedial units (RUs) identified in the CAP and CAP Addendum for the Site. The CAP Addendum described:

- An amendment to the proposed corrective action for the portions of the Building 231 and Building 228 RUs that abut the historic wall in the southern portion of the site—herein referred to as the "historic wall interface"—that allows for implementation of in situ chemical oxidation (ISCO) and oxygen release compound (ORC) injection, as necessary, to address residual contamination in the subsurface that can not be excavated without endangering the structural integrity of the historic wall; and

- How the Trust, in consultation with the Water Board, will develop a methodology to assess if concentrations of metals in native soils at the Site are indicative of site contamination or naturally occurring background conditions. The methodology will incorporate confirmation sampling data collected as part of the remediation program, to assist in assessing the distribution of metals in soil and decisions regarding excavation.

This Work Plan identifies the fieldwork components of implementing the corrective actions to address soil and groundwater contamination related to or co-located with releases of petroleum hydrocarbons from past uses of the Site. Construction Documents accompanying this Work Plan provide additional detail regarding requirements of the Excavation Contractor (Contractor) for the excavation component of the corrective actions (*MACTEC, 2008c*). As described in this Work Plan, MACTEC and the Trust will manage and implement other components of the corrective actions not related to excavation under separate contracts.

## 1.1 Background

The Site comprises approximately eight acres of land located in the northeastern portion of the Presidio of San Francisco, California (Presidio), adjacent to the Crissy Marsh and bisected by the Doyle Drive/Highway 101 overpasses (Figure 1-1). Approximately 6 acres of the site is paved (from the southern boundary to the North Doyle Drive overpass) and the remaining 2 acres to the north of the North Doyle Drive overpass is unpaved.

The Site is within the Presidio of San Francisco National Historic Landmark District. Historic resources designated for preservation within the Site include several historic buildings and historic walls. Potential planned uses of the Building 207/231 Area include onsite restoration of the Quartermaster's Reach of the adjacent Crissy Marsh and freshwater Tennessee Hollow Riparian Corridor adjacent to an historic wall in the southern portion of the Site, replacement of the Doyle Drive/Highway 101 overpasses, and continued or future use of existing buildings by tenants and preservation of historic structures.

The United States Department of the Army (Army) historically used the Site for servicing and fueling vehicles. The Site formerly contained two service/gas stations, garages, a car wash, a dry cleaning facility, and fuel oil distribution lines. The garages, car wash, underground storage tanks (USTs), and fuel lines have since been removed and the Site currently consists of buildings, paved parking areas, roadways, and some landscaping. Several utilities, both in-service and abandoned, pass through the Site. A below-ground 72-inch storm drain runs through the eastern portion of the Site that drains to Crissy Marsh. The southern portion of the Site contains several historic structures that will be preserved, including Building 201, Building 227, Building 228, Building 229, Building 230, and the historic walls shown on Figure 1-2.

***Previous Investigations and Corrective Actions***

Previous investigations conducted by the Army consisted of a Preliminary Assessment, Site Investigation, Remedial Investigation, and a CAP. The Trust conducted a site characterization investigation to address data gaps identified from review of results of previous investigations, and has been conducting a quarterly groundwater monitoring program at the Site. Previous corrective actions included removal of USTs, fuel distribution system (FDS) lines, and over-excavation of associated petroleum-contaminated soils in the following areas:

- FDS Section BR10-1
- USTs 207.1, 207.2, 207.3, 228.1, 228.2, 228.3, 231.1, 231.2, and 231.4 through 231.7

- Hydraulic Oil Lifts H1 through H6
- Former Building 271 Garage
- Car wash
- Sump 208.

The CAP presented the detailed results of the previous investigations and corrective actions (*MACTEC, 2007*).

***Geologic and Hydrogeologic Conditions***

The Building 207/231 Area is located at the boundary of the Northwestern and Crissy Field groundwater areas of the Marina Groundwater Basin. The Site gently slopes to the north with elevations ranging from approximately 30 to 10 feet above the North American Vertical Datum (NAVD) 88 (Figure 1-2).

In general, as shown on the cross-sections presented on Figures 1-3 through 1-5, unconsolidated sediments of the Colma formation underlie the Site, over which a layer of fill of variable thickness ranging up to approximately 15 feet occurs.

The main water-bearing zones in the Building 207/231 Area are the shallow, intermediate, and deep zones. These three relatively permeable, sandy, water-bearing zones are typically separated by horizons of less permeable, clayey, fine-grained estuarine deposits (Bay Mud) observed across the Crissy Field Groundwater Area.

Previous investigations indicate the upper units comprise fill and shallow sand underlain by Bay Mud in the northern part of the Site and a silt unit (likely Colma formation) in the southern part of the Site. The Bay Mud and silt units are underlain by silty sands identified as the upper and lower intermediate sand. MACTEC and Anthropological Studies Center, Sonoma State University (ASC) conduced a subsurface geoarchaeological survey in January 2006 to assess potential cultural and/or historic resources in areas planned for excavation prior to implementation of the approved corrective actions. The results of the survey are summarized in the CAP, and presented in the *Draft Subsurface Geoarchaeological Survey of the Building 207/231 Area, Presidio of San Francisco, City and County of San Francisco, California* (*ASC & MACTEC, 2006*). The subsurface geology within nine trenches excavated at the Site was generally consistent with data from previous investigations that indicate varying strata of fill, sands, silts, and clays, with some discontinuous occurrences of gravel fill containing anthropogenic material *(ASC &*

*MACTEC, 2006).* Cross-section Figures 1-3 through 1-5 illustrate geoarchaeological survey trenches excavated within the Site. The lower strata of the trenches contained evidence of native soil in the form of gray fat clay, dark gray, brown, and black poorly-graded sand, and light yellowish brown poorly-graded sand. The gray fat clay typical of Bay Mud deposits was generally discontinuous at the depths excavated within the trenches.

Groundwater generally flows north in all three water-bearing zones with some minor variations in flow directions. Groundwater in the shallow groundwater zone is unconfined and groundwater flow is to the northeast. The intermediate groundwater zone consists of the intermediate/shallow sand, upper intermediate sand, and lower intermediate sand. Groundwater in the intermediate zone is semi-confined and groundwater flow is generally to the north. There is an upward vertical gradient between the intermediate and shallow groundwater zones in the northern and central portions of the Site.

Depth to groundwater across the Site varies seasonally; seasonal fluctuations are influenced by precipitation events and tidal influence. Results of groundwater monitoring indicate low groundwater levels across the Site during the end of the summer to early winter and high groundwater levels during late winter to early spring.

Groundwater monitoring data (both water levels and water quality data) indicate that the low permeable Bay Mud layer combined with the upward vertical groundwater gradient from the intermediate groundwater zone to the shallow groundwater zone have effectively mitigated downward migration of chemical contaminants. Groundwater quality data indicate reducing conditions in the shallow groundwater zone in the northern part of the Site where fill and the shallow sand are underlain by Bay Mud.

***Coordination of Corrective Actions with Future Site Use***

Future plans for use of the Building 207/231 Area include onsite restoration of the Quartermaster's Reach portion of the adjacent Crissy Marsh and freshwater Tennessee Hollow Riparian Corridor. In addition, there are plans to replace the Doyle Drive/Highway 101 Overpasses that extend into the northern portion of the Site, as well as continued and future use of existing buildings by tenants, and preservation of historic structures.

The CAP developed corrective action alternatives to address the following resources and planned reuses for the Site:

- Preservation of historic Buildings 228, 229, and the historic wall in the southern portion of the Site;
- Replacement of the Doyle Drive/Highway 101 overpasses in the northern portion of the Site; and;
- Restoration of the Quartermaster's Reach of the adjacent Crissy Marsh and freshwater Tennessee Hollow Riparian Corridor through the Site, adjacent to the historic wall between Buildings 228 and Building 231.

## 1.2 Remedial Action Objectives, Cleanup Levels, and Chemicals of Concern

The Remedial Action Objectives (RAOs) identified in the CAP for the Building 207/231 Site include:

- Protection of human health and the environment;
- Cost-effective cleanup of the Site consistent with its potential land use;
- Recycling excavated materials such as concrete and asphalt to the extent practicable;
- Compliance with State and Federal environmental laws;
- Consistency of the approved corrective actions to be implemented at the Site with the overall transformation of the Presidio into a national park site; and
- Preference for permanent ("clean closure") remedies whenever practicable, cost-effective, and consistent with current or anticipated land use.

Based on these RAOs and Site data, the CAP identified cleanup levels for soil and groundwater at the Site as presented in Tables 1-1 and 1-2, respectively. For soil, the cleanup levels were divided into two categories:

- For remedial units south of and underneath the Northern Doyle Drive Overpass structure, the lowest applicable cleanup levels for protection of (1) human health residential, (2) ecological special status, (3) freshwater sediment and (4) saltwater sediment, from the CAP will be used as soil cleanup levels. For metals, due consideration will be given to confirm that cleanup levels are not lower than those that are indicative of background conditions. Both freshwater and saltwater sediment cleanup levels apply to these remedial units because this area is within the freshwater

ecological protection zone but restoration of the Quartermaster's Reach of the adjacent Crissy Marsh is also planned for expansion in the area. Brackish water (a mixture of freshwater and saltwater) is expected. These cleanup levels apply to the Building 228 RU, Building 231 RU, Building 230 RU, the southern portion of the Building 207 RU, and the southern portion of the Building 38 RU.

- For remedial units north of the Northern Doyle Drive Overpass structure, the lowest applicable cleanup levels for protection of (1) human health residential, (2) ecological special status, and (3) saltwater sediment, from the CAP will be used as soil cleanup levels. For metals, due consideration will be given to confirm that cleanup levels are not lower than those that are indicative of background conditions. For sediment, only saltwater sediment cleanup levels apply to these remedial units because this area is within the saltwater ecological protection zone and is also planned for the Crissy Marsh expansion. These cleanup levels apply to the northern portion of the Building 207 RU and the northern portion of the Building 38 RU.

For groundwater, the lowest applicable cleanup levels for protection of drinking water, saltwater, and freshwater from the CAP will be used as groundwater cleanup levels.

For lead in soil, the Water Board Order R2-2003-0080 lists a cleanup level of 50 milligrams per kilogram (mg/kg) for protection of ecological terrestrial receptors. This value only applies to leaded gasoline releases and not releases from other sources including diesel and fuel oil. Therefore, for the corrective action at the Building 207/231 Area, the lead cleanup level of 50 mg/kg will only be applied if TPH as gasoline and/or benzene, toluene, ethylbenzene, xylenes (BTEX) are also detected above their respective cleanup levels. If TPH as gasoline and BTEX concentrations are below cleanup levels and there is no visual or olfactory evidence of remaining gasoline contamination, the alternate lead cleanup levels provided in Table 1-1 will be used: 82 mg/kg for RUs south of and underneath the Northern Doyle Drive overpass, and 132 mg/kg for RUs north of the Northern Doyle Drive overpass.

***Site-Wide Chemicals of Concern***

The remedial units (RUs) are areas where COCs were detected at concentrations exceeding cleanup levels in soil and/or groundwater. Figures 1-6 and 1-7 show the extent of soil and groundwater RUs. Figure 1-8 shows the associated corrective action areas. Based on the occurrence of chemicals in soil at concentrations exceeding cleanup levels, the CAP identified the following chemicals of concern (COCs) for soil:

- Petroleum hydrocarbons – Total Petroleum Hydrocarbons (TPH) as gasoline, diesel, fuel oil;
- Volatile Organic Compounds (VOCs) – benzene, toluene, ethylbenzene, xylenes (BTEX), methyl tertiary butyl ether (MTBE), tetrachloroethene (PCE), trichloroethene (TCE), vinyl chloride (VC), bromobenzene, methylene chloride (MeCl);
- Polynuclear Aromatic Hydrocarbons (PAHs) – anthracene, acenaphthylene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(b+k)fluoranthene, benzo(k)fluoranthene, chrysene, fluoranthene, phenanthrene, pyrene;
- Polychlorinated Biphenyls (PCBs) and Pesticides – Arochlor 1016, 4,4'-DDD; and
- Metals – arsenic, chromium, cobalt, copper, lead, mercury, silver, and zinc.
- For groundwater, the CAP identified the following COCs:
- Petroleum hydrocarbons – TPH as gasoline, diesel, fuel oil;
- VOCs – BTEX, MTBE, bromobenzene, 1,2-dichlorobromine (1,2-DCB), 1,2-dichloroethane (1,2-DCA), PCE, TCE, VC;
- PAHs – benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(b+k)fluoranthene, benzo(k)fluoranthene, chrysene, and indeno(1,2,3-cd)pyrene;
- PCBs – Arochlor 1016; and
- Metals – arsenic, lead, nickel, vanadium, and zinc.

In 2006, the Trust conducted a study to further evaluate the presence of arsenic in groundwater and its relationship to petroleum hydrocarbons, soil types, and groundwater chemistry at the Building 207/231 Area, and two neighboring CAP sites—the Building 1065 Area and the Commissary/PX Area—as presented in the *Technical Memorandum, Evaluation of Arsenic and Other Metals in Groundwater at Three Corrective Action Plan Sites, Presidio of San Francisco, California* (*MACTEC, 2006a*). Based on the results of the study, elevated dissolved arsenic concentrations in groundwater at the Site are likely the result of geochemical changes caused by locally reducing conditions from degradation of petroleum hydrocarbons in the shallow groundwater zone, and to a lesser extent from degradation of organic matter

in the Bay Mud underlying the Site. Consequently, corrective actions for the Site include groundwater monitoring for arsenic.

## 1.3 Project Team Responsibilities

Key project team members include the Trust as Owner, MACTEC as the Construction Manager, and the contractors that will implement the corrective actions identified on Figure 1-9, as well as the project team members including the Water Board, NPS, Department of Toxic Substances Control (DTSC), and Presidio Restoration Advisory Board (RAB). Table 1-3 describes the responsibilities of the project team in implementing the pre-construction, construction, and post-construction corrective action activities that are described in detail in Section 3.0. Table 1-4 presents the key points of contact on the project team.

For this project:

- Ryan Seelbach of the Trust is the Remedial Project Manager responsible for implementation of the approved corrective actions.
- Brian Ullensvang, P.E. is the NPS representative and will coordinate with NPS specialists during project planning and corrective action activities.
- Ramkishore Rao (MACTEC) is the Professional Engineer (P.E.) and design engineer for the project. MACTEC's Construction Manager to be identified for the project will be responsible for providing weekly construction reports, which will include field and laboratory documentation from the previous week. Stacy Sabol is MACTEC's project manager for the project. MACTEC will also collect confirmation samples and evaluate results, and will prepare the Construction Completion Report that certifies Construction Quality Assurance (CQA).
- MACTEC will perform in situ remediation, effectiveness monitoring, and in-situ confirmation sampling for the portions of the Building 228 and 231 RUs that occur at the historic wall interface, and outdoor cap inspection at the Building 228 RU, report preparation for implementation of LUCs, and in-situ HydroPunch sampling at Building 230 RU.
- T&R will abandon and install wells and will perform groundwater monitoring.
- EKI will conduct the indoor air and cap assessment at the Building 228 RU.

- The Excavation Contractor (referred to as "Contractor"; to be selected), who will perform excavation will be determined after the Trust's excavation bidding and procurement process is completed.
- Archaeologists subcontracted by MACTEC will perform archaeological monitoring for the Site.
- Drillers subcontracted by MACTEC, EKI, and T&R will perform in situ injection and sampling, sub-cap soil gas sampling, and well installation and abandonment for the Site, respectively.

## 1.4 Corrective Action Contracting

This section identifies the contracting involved in the implementation of each corrective action component. Details related to implementation of these corrective actions, including schedules, contracting, and reporting requirements and responsibilities are described in Sections 2.0 through 6.0.

The Trust will procure the contractors, and the Construction Manager (MACTEC) will manage the Trust's contractors to implement the corrective actions as shown on Figure 1-9 and summarized below:

- <u>MACTEC</u>: Design Engineer; Construction Manager; Building 228 RU Outdoor Cap Inspection Contractor; and Building 228 and Building 231 RUs In Situ Remediation Contractor, Land Use Control Contractor, and In Situ Sampling Contractor;
- <u>EKI</u>: Building 228 Indoor Air and Cap Assessment Corrective Action Contractor;
- <u>T&R</u>: Groundwater Monitoring and Well Abandonment/Installation Contractor; and
- <u>Excavation Contractor (Contractor)</u>: To be Determined.

Demolition of Building 231 and the aboveground SVE equipment will be completed prior to initiation of the corrective actions proposed in this Work Plan. Therefore, the demolition scope is excluded from this Work Plan.

The accompanying Construction Documents provide additional detail regarding requirements of the Excavation Contractor for the excavation component of the corrective actions (*MACTEC, 2008c*). As described in this Work Plan, the Trust will manage and implement other components of the corrective actions not related to excavation under separate contracts.

# 2.0 CORRECTIVE ACTIONS

This section summarizes the remedial units identified and approved corrective actions selected for implementation in the CAP and CAP Addendum (*MACTEC, 2007, 2008b*).

The remedial units (RUs) are areas where COCs were detected at concentrations exceeding cleanup levels in soil and/or groundwater shown on Figures 1-6 and 1-7. Based on the occurrence of COCs at concentrations exceeding cleanup levels, the CAP identified the following five soil RUs and four co-located groundwater RUs at the Site:

<u>Southern Portion of Site at the Historic Wall Interface:</u>

1. The existing Building 228 RU that in its northern portion is adjacent to the historic wall and associated with former USTs, and in its southern portion is associated with former FDSs; and the southern portion of the Building 231 RU adjacent to the historic wall

<u>Northern and Central Portions of Site</u>:

2. Former Building 207 fueling station and adjacent Former Building 208 sump in the northern portion of the Site (Former Building 207 RU);

3. Former Buildings 38, 38-A, and garage oil station in the northeastern portion of the Site (Former Building 38 RU);

4. Existing Building 231 and former service station complex in the central part of the Site (Building 231 RU), including a small adjacent area associated with the Former Building 271 garage; and

5. Existing Building 230 adjacent to a former railroad spur loading dock in the eastern portion of the Site (Building 230 RU [Groundwater was not sampled in this area; however, saturated soils were sampled at intervals of 7.5 and 10 feet bgs, and no COCs were detected above cleanup levels within saturated soil samples. Therefore, this is the only soil RU at the Site that is not co-located with an identified Groundwater RU.]).

The corrective actions selected for the RUs differ according to the portion of the Site where they are located as follows:

***Corrective Actions for Southern Portion of Site at the Historic Wall Interface:*** These corrective actions were selected because residual contamination is present between the historic building and wall, adjacent

to both sides of the wall, and directly upgradient of the Building 231 excavation area, and source removal by excavation will not be implemented to prevent potential damage to adjacent historic structures that are important cultural resources designated for preservation.

The approved corrective action for the portions of the Building 231 RU and Building 228 RU that occur in the southern portion of the Site at the historic wall interface consist of in situ remediation on both sides of the historic wall. New data collected adjacent to the historic wall since the CAP was prepared (within the Building 231 RU and directly downgradient of the Building 228 RU) indicates concentrations of petroleum hydrocarbons are significantly above previously documented concentrations and/or cleanup levels. Therefore, the CAP Addendum documented the revised corrective action for combined remediation of both portions of the Building 231 and 228 RUs in this area. As the first step of the combined approach, samples will be collected and analyzed for COCs from four soil borings, 2 each on the eastern and western sides of the portion of the Building 231 RU defined as the “wedge” of soil within the excavation setback (from the wall to approximately 5 feet north of the wall at the surface of the RU, sloping downward to approximately 10 feet north of the wall at the bottom of the RU, and extending laterally over a span of approximately 30 feet) where excavation can not be implemented without endangering the structural integrity of the historic wall.

After data has been analyzed to further evaluate the extent of contamination and potentially revise the design parameters for in situ remediation, a chemical oxidation compound (RegenOx™) will be injected within the Building 231 RU in a series of four injection events over a period of approximately 6 weeks, with the intent of aggressively oxidizing and significantly reducing petroleum hydrocarbon concentrations where they are documented as significantly above cleanup levels in soil and groundwater within this area. After in situ remediation using RegenOx™ is completed within the Building 231 RU, a slower-acting, time-release oxygen releasing compound (ORC Advanced™) will then be injected within both the Building 231 and 228 RUs with the intent of stimulating biodegradation of lower-level residual petroleum hydrocarbons and reducing concentrations in the saturated zone of the subsurface below cleanup levels as a final “polishing” step over a period of approximately 12 months.

As a contingency, the corrective action may also include injection of RegenOx™ within the Building 228 RU prior to injection of ORC Advanced™, if based on an evaluation of the results of sampling within the Building 231 RegenOx™ injection area and in consultation with Regenesis, Inc. (the manufacturer of both compounds) and the Water Board, it is indicated as a beneficial adjunct to the remediation approach in meeting cleanup levels. The corrective actions for the historic wall interface also include groundwater

monitoring and a LUC for the Building 228 RU and portion of the Building 231 RU that will not be excavated and will undergo in situ remediation.

The corrective action for the Building 228 RU also includes inspection of the existing indoor cap, and the building foundation and outdoor cap (paved areas) in the northern and southern portions of the RU, and improvements and maintenance, as necessary. Soil gas sampling will be conducted to assess vapor intrusion to indoor air, and will be followed by indoor air monitoring for any chemicals reported in the soil gas samples if potentially significant risks to future building occupants are identified.

***Corrective Actions for Northern and Central Portions of Site:*** The approved corrective action for the four RUs that occur in the northern and central portions of the Site—Former Building 207 RU, Former Building 38 RU, Building 231 RU, and Building 230 RU—consists of removing petroleum-contaminated soil that is considered to be the source of contamination to groundwater to achieve clean closure for unrestricted reuse. This will be achieved through excavation and offsite disposal of contaminated soils and backfill with natural sands, followed by downgradient groundwater monitoring to confirm source removal has reduced impacts to groundwater. Temporary LUCs will also be implemented for portions of these RUs where contaminated soil is present beneath structures that will not be removed during currently planned excavation activities.

***Site-Wide Corrective Actions:*** Implementation of groundwater monitoring and LUCs are components of the corrective actions for all of the RUs site-wide as described above. The Trust will perform groundwater monitoring as described herein under the Presidio-Wide Groundwater Monitoring Program and prepare semi-annual and annual monitoring reports with recommendations for any modifications to the program over time. The Trust will also prepare a site-specific LUC Addendum to the LUCMRR as described herein for areas of residual contamination. All LUC areas will be surveyed in the field and will be depicted on a map. LUCs for the site are anticipated as follows: (a) a temporary LUC for soil beneath structures that will be lifted when clean closure is achieved after future site activities remove these structures to access and excavate contaminated soils during the eventual Doyle Drive replacement project construction; (b) a LUC for areas where in situ remediation will be conducted that may be lifted if concentration of COCs are reduced below cleanup levels over time; and (c) a LUC for groundwater that will be lifted when cleanup levels have been met under the post-construction groundwater monitoring program. The Trust will perform a review of protectiveness of LUC corrective actions every five years.

Figures 1-6 and 1-7 shows the RUs defined in the CAP. Figure 1-8 shows the associated corrective action areas (i.e., excavation areas and LUC areas). To facilitate implementation of the CAP remedy and to

maximize removal of contaminated soils, MACTEC made the following minor adjustments to the LUC and assumed excavation boundaries (shown on Figure 1-8) from those presented in the CAP figures:

Excavation Areas

The Construction Drawings included in the accompanying Construction Documents (*MACTEC, 2008c)* square off the rounded portions of the CAP RU boundaries within assumed excavation areas to incorporate known locations where concentrations of COCs in soil exceed cleanup levels (as described in Section 2.1 below) and facilitate constructability. The Contractor will stockpile soil removed from the assumed excavation areas for characterization and offsite disposal and will not segregate clean from impacted soil.

At the Building 207 RU, prior to excavation construction activities, a minimum of three soil samples will be collected from within the footprint of the LTTD-treated backfill within the footprint of the RU to verify whether concentrations of COCs in the backfill materials exceed cleanup levels and require excavation (see Appendix I; Sampling and Analysis Plan for Corrective Actions). The plans herein assume excavation of these materials; however, if sampling results indicate cleanup levels are not exceeded within the backfill material, then the materials will be left in place or reused onsite, and their location and extent will be recorded and managed in accordance with the *Low Temperature Thermal Desorption-Treated Soil Tracking and Management Plan* (LTTD Management Plan; *EKI, 2004*) and requirements of Water Board Order R2-2003-0080.

These areas also include eight other geoarchaeological trench locations (besides the one in the 207 RU) from which the Contractor will excavate and dispose offsite trench backfill material. The Contractor will stockpile soil removed from the trenches for characterization and offsite disposal. To the extent that uncontaminated soil can be physically separated from contaminated soils, the Contractor will separate clean from contaminated soils.

LUC Areas

The Construction Drawings included in the accompanying Construction Documents (*MACTEC, 2008c)* square off portions of the CAP RU boundaries within LUC areas to incorporate known locations where concentrations of COCs in soil exceed cleanup levels (as described in Section 2.1 below) that will not be excavated due to the presence of adjacent structures that are either: (1) historic and designated for preservation; or (2) occur beneath or directly adjacent to the overpass structure beneath Doyle Drive that will be excavated in the future under the Doyle Drive reconstruction project. Following concurrence from

the Water Board in regular stakeholder meetings, the licensed land surveyor subcontracted by the Contractor will survey LUCs for depiction on areal topographic map to be included as a site-specific addendum to the LUCMRR.

## 2.1 Summary of Remedial Units and Corrective Actions

The following sections summarize the five soil RUs and four groundwater RUs and corrective actions identified in the CAP, and provides a detailed description of each of the corrective action components for the Site that consist of:

- Source removal by excavation of contaminated soils and offsite disposal from the Building 230, Former Building 38, Former Building 207, and Building 231 RUs;

- Backfilling excavations with naturally derived sand;

- At the historic wall interface (southern portion of the Building 231 RU and northern portion of the Building 228 RU) where source removal by excavation will not be implemented to prevent potential damage to adjacent historic structures that will be preserved, the corrective action includes (a) in situ remediation of saturated soils and groundwater(b) implementation of a LUC for residual soil and groundwater contamination. The corrective action for the Building 228 RU also includes: (c) assessment of potential vapor intrusion to indoor air within historic buildings in the LUC area; (d) indoor and outdoor cap inspection and improvements as necessary; and (e) long term maintenance and management of the cap and LUC area;

- Groundwater monitoring, well abandonment, and new well installation;

- Implementation of LUCs for areas of residual contamination as follows: (a) a temporary LUC for soil beneath structures that will be lifted when clean closure is achieved after future site activities remove these structures to access and excavate contaminated soils; (b) a LUC for areas where in situ remediation will be conducted that may be lifted if concentrations of COCs are reduced below cleanup levels over time; and (c) a LUC for groundwater that will be lifted when cleanup levels have been met under the post-construction groundwater monitoring program.

Figure 2-1 presents the historic high groundwater elevations at the Site. Figures 2-2A and 2-2B present the planned excavation areas for the RUs.

### 2.1.1 Building 228 Remedial Unit Corrective Action

This RU is located on the south side of the project area on the north and south sides of Historic Building 228 as shown on Figure 1-2. The impacted soil at this area is co-located with impacted groundwater in the northern portion of the RU associated with the former Building 228 USTs.

***Remedial Unit***

Northern Building 228 RU: This portion of the RU occurs between the northern edge of the Building 228 foundation and the historic wall, and extends just beneath the wall. The impacted soil in the northern portion of this RU is located in unsaturated and saturated soil. Figure 1-6 shows COCs detected in soil and groundwater at concentrations that exceed cleanup levels in this RU.

Southern Building 228 RU: This portion of the RU occurs outside the southeastern edge of the Building 228 foundation, and extends beneath the foundation corner. Impacted soil in the southern area of this RU is located within the former excavation associated with the FDS lines, and is located immediately adjacent to the south side of the historic Building 228. Soil contamination is located in vadose zone soil at a depth of 6 feet bgs. Figure 1-6 shows COCs detected in soil at concentrations that exceed cleanup levels in this RU.

***Summary of Corrective Action***

Northern Building 228 RU at Historic Wall Interface: This portion of the RU occurs between the northern edge of the Building 228 foundation and the historic wall, and extends just beneath the wall. Details of the corrective action are summarized in Section 3.1.7 and presented in Appendix E (In Situ Remediation at Historic Wall Interface, Northern Portion of Building 228 Remedial Unit and Southern Portion of Building 231 Remedial Unit) and Appendix H (Indoor Cap Inspection and Air/Soil Vapor Sampling, Building 228 Remedial Unit). MACTEC will perform in situ remediation of the northern portion of the RU by injecting an oxygen releasing compound in this area to enhance biodegradation of residual petroleum-contaminated saturated soils and groundwater in a manner that will not endanger the historic structures (Building 228 and the wall). Figure E-1 of Appendix E shows the injection area, and Figure E-2 shows a cross-section of the injection area. This area has several utilities crossing its boundaries including a fire hydrant on the west side, and natural gas on the north side of the existing building. There are also overhead power lines located within the area.

Building 228: The corrective action for the Building 228 RU also includes inspection of the existing indoor cap, and the building foundation and outdoor cap (paved areas) in the northern and southern portions of the RU, and improvements and maintenance, as necessary. Soil gas sampling will be conducted to assess vapor intrusion to indoor air, and will be followed by indoor air monitoring for any chemicals reported in the soil gas samples if potentially significant risks to future building occupants are identified.

Southern Building 228 RU: This portion of the RU is paved and is located outside the southeastern edge of the Building 228 foundation, and extends beneath the foundation corner. The Trust will implement a LUC in this portion of the RU because COC concentrations were detected above cleanup levels in this area that (1) are not anticipated to be able to be removed by excavation without endangering the structural integrity of the building foundation, and (2) are heavy hydrocarbons (e.g., TPH as fuel oil and TPH as diesel) that occur in unsaturated soils that are not treatable via in-situ methods. Figure 1-8 shows the LUC area.

### 2.1.2 Building 230 Remedial Unit Corrective Action

The planned excavation area is located on the east side of the project site. The boundaries are within the asphalt paved parking lot on the east side of existing historic Building 230 as shown on Figure 1-2. The only known utility to cross the area is a water line running north / south through the area. An abandoned railroad spur and associated debris may exist within the excavation area.

#### *Remedial Unit*

Impacted soil in this area is associated with railroad activities conducted east of existing Building 230, which includes a portion of the railroad spur. The COCs that were detected in soil at concentrations above cleanup levels are shown on Figure 1-7.

Groundwater was not sampled in this area; however, saturated soils were sampled at intervals of 7.5 and 10 feet bgs, and no COCs were detected above cleanup levels within saturated soil samples. Therefore, this is the only soil RU at the Site that is not co-located with an identified Groundwater RU.

#### *Summary of Corrective Action*

Prior to initiation of corrective action, the Contractor will remove the water service from Gorgas Avenue, which traverses through the excavation (and located to the east of Building 230) and provides portable water service to Building 230 by extending the water line from the south.

The corrective action implementation for this RU is excavation and offsite disposal of soil; backfilling the excavation with naturally derived sand; and groundwater monitoring. The Contractor will excavate contaminated soil (including geoarchaeological trench backfill materials) and dispose of excavated material offsite at a Trust-approved disposal facility. Backfilling, grading, and restoration activities are described in Section 3.2.8. Following completion of excavation, the Contractor will reinstall water service from Gorgas Avenue.

Because groundwater associated with this RU has not been sampled, MACTEC will collect two HydroPunch samples following completion of excavation and prior to backfilling this RU to verify COCs above cleanup levels are not present in groundwater. Groundwater samples will be collected from intermediate sands underlying the Bay Mud as described in Appendix I (Sampling and Analysis Plan for Corrective Actions). The cross-section shown on Figure 1-5 also suggests the top of Bay Mud will be encountered between 3 and 4 feet bgs.

The Contractor will excavate, stockpile, characterize, and dispose offsite geoarchaeological trench backfill material from the trench located in the RU.

The Contractor will excavate the Building 230 RU vertically to a depth such that known COCs in soil are removed and until soil confirmation sampling results for all COCs indicate that cleanup levels are met within the excavation bottom as described in Appendix I (Sampling and Analysis Plan for Corrective Actions). The horizontal limits of the excavation are discussed below in Section 2.1.6.

### 2.1.3 Former Building 38, 38-A, and Garage Area Remedial Unit Corrective Action

The northern Doyle Drive/Highway 101 Overpass bisects the excavation area for this RU. The planned excavation north of the overpass is located in a lightly vegetated area (turf grass) (see Figure 1-2 for location of RU). The excavation south of the overpass is in a level asphalt paved area where no known utilities traverse through the planned excavation.

***Remedial Unit***

The impacted soil in this area is co-located with impacted groundwater associated with use of the former Building 38, 38-A, and garage areas. Figure 1-6 shows COCs detected in soil and groundwater at concentrations above cleanup levels.

***Summary of Corrective Action***

The corrective action implementation for this RU is excavation and offsite disposal of soil; backfilling the excavation with naturally derived sand; and groundwater monitoring. The Contractor will excavate contaminated soil (including geoarchaeological trench backfill materials) and dispose of excavated material offsite at a Trust-approved disposal facility. Backfilling, grading, and restoration activities are described in Section 3.2.8.

Saturated soil is between approximately 7 to 8 feet bgs in this area based on soil boring data. Soil boring data from this area also suggests the top of Bay Mud is between 3 and 8 feet bgs. There are no shallow groundwater zone monitoring wells in the immediate vicinity of this RU.

Geoarchaeological trench backfill: The Contractor will excavate, stockpile, characterize, and dispose offsite geoarchaeological trench backfill material from the trench in this RU.

Excavation: The vertical depth of excavation shall be such that known COCs above cleanup levels are removed and until soil confirmation sampling results for COCs indicate that cleanup levels are met within the excavation bottom as described in Appendix I (Sampling and Analysis Plan for Corrective Actions). The horizontal limits of the excavation are discussed in Section 2.1.6.

### 2.1.4 Former Building 207 Remedial Unit (Including Former Building 208 Sump Area) Corrective Action

The former Building 207 RU is located on the north side of the project area and includes the former Building 207 area and the former Building 208 Sump area as shown on Figure 1-2.

The former Building 207 area is on the north side of the northern Doyle Drive/Highway 101 Overpass. The surface of this area contains light vegetation (turf grass and weeds) and is bounded to the north by Old Mason Street, to the west by Halleck Street, and to the south by the overpass. A below grade communication line conduit and several irrigation lines cross the excavation.

The former Building 208 Sump area is between the northern and southern Doyle Drive/Highway 101 overpasses. The planned excavation area is at level grade and is paved with asphalt concrete (AC).

The two areas of soil contamination in this RU are co-located with an area of groundwater contamination associated with the former Building 207 USTs.

***Remedial Unit***

The majority of soil containing COCs above cleanup levels in the Building 207 area is located in the vadose zone from 3 to 3.5 feet bgs. This area includes low temperature thermal desorption (LTTD) material the Army used to backfill an historical excavation associated with the removal of USTs in this area. The COCs that were detected in soil and groundwater at concentrations above cleanup levels in this location are shown on Figure 1-6.

Soil containing COCs above cleanup levels associated with the former Building 208 sump is located in saturated soil from 5 to 7.5 feet bgs. The COCs that were detected in groundwater at concentrations above cleanup levels at this area occur in the shallow aquifer at typical depths ranging from 7 to 16 feet bgs.

***Summary of Corrective Action***

The corrective action implementation for this RU is: excavation and offsite disposal of soil (including LTTD material if sample results indicate that COCs are above cleanup levels); backfilling the excavation with naturally derived sand; and groundwater monitoring. The Contractor will excavate contaminated soil (including geoarchaeological trench backfill materials) and dispose of excavated material offsite at a Trust-approved disposal facility. Backfilling, grading, and restoration activities are described in Section 3.2.8.

For the Former Building 207 portion of the RU, saturated soil is at about 5 feet bgs in this area based on an historical high groundwater elevation monitored in nearby shallow zone groundwater monitoring well 231GW16 shown on Figure 2-1. The cross-sections shown on Figures 1-3 and 1-5 suggest the top of Bay Mud is between approximately 8 and 17 feet bgs within the RU. For the Former Building 208 Sump portion of the RU, saturated soil is approximately 5 feet bgs in this area based on the cross-section shown on Figure 1-3. The cross-section shown on Figure 1-3 also suggests the top of Bay Mud is between 8 and 9 feet bgs.

<u>Sampling of Low Temperature Thermal Desorption (LTTD) Treated Backfill Materials</u>: At the Building 207 RU, prior to excavation construction activities, a minimum of three soil samples will be collected from within the footprint of the LTTD-treated backfill within the footprint of the RU to verify whether concentrations of COCs in the backfill materials exceed cleanup levels and require excavation (see Appendix I; Sampling and Analysis Plan for Corrective Actions). The plans herein assume excavation of these materials; however, if sampling results indicate cleanup levels are not exceeded within the backfill

material, then the materials will be left in place or reused onsite, and their location and extent will be recorded and managed in accordance with the *Low Temperature Thermal Desorption-Treated Soil Tracking and Management Plan* (LTTD Management Plan; *EKI, 2004*) and requirements of Water Board Order R2-2003-0080. Further, the Contractor will notify the Construction Manager upon encountering LTTD material (observation of materials typically of a dark grey granular material with low organic content, with geotextile fabric and gravel backfill marking the LTTD material interface) within excavations so that its location, extent, and offsite disposal can be recorded and managed in accordance with the LTTD Management Plan (*EKI, 2004*) and requirements of Water Board Order R2-2003-0080.

Excavation: The Contractor will excavate Former Building 207 RU and the Former Building 208 Sump Area to remove known COCs above cleanup levels and until soil confirmation sampling results for all COCs indicate that cleanup levels are met within the excavation bottom as described in Appendix I (Sampling and Analysis Plan for Corrective Actions). The horizontal limits of the excavation are discussed below in Section 2.1.6. During excavation, irrigation lines within this area will be removed; these lines will be replaced following backfilling (see Section 3.2.9).

### 2.1.5 Building 231 Remedial Unit (Including Former Building 271 Area) Corrective Action

This RU is located in the central portion of the project area, and includes the former Building 271 area (see Figure 1-2). To the north, this RU is adjacent to and extends under the southern Doyle Drive/Highway 101 Overpass structure. To the south, this RU abuts the historic wall just north of the Building 228 RU. A variety of utilities including water, storm drain, electric, sewer, communications, and natural gas run through the planned excavation area. Existing Building 231 is located within the planned excavation limits, and will be demolished prior to implementation of corrective action activity described in this Work Plan. The entire area is asphalt or concrete paved and slopes approximately 1.5 percent from southwest to northeast with Gorgas Avenue crossing the north side of the RU.

Excavation beneath Gorgas Avenue may be deferred if the work can be combined with the Doyle Drive reconstruction project.

***Remedial Unit***

The impacted soil in the Building 231 area is co-located with impacted groundwater associated with the former Building 231 USTs. The impacted soil is located in unsaturated and saturated zone soils.

The Former Building 271 area contained a garage at the north end of the building. This area contains one location where COCs were detected in soil and groundwater slightly above cleanup levels.

The COCs that were detected in soil and groundwater at concentrations above cleanup levels are shown on Figure 1-7.

***Summary of Corrective Action***

Southern Building 231 RU at Historic Wall Interface: This portion of the RU is defined as the "wedge" of soil within the excavation setback (from the wall to approximately 5 feet north of the wall at the surface of the RU, sloping downward to approximately 10 feet north of the wall at the bottom of the RU, and extending laterally over a span of approximately 30 feet) where excavation can not be implemented without endangering the structural integrity of the historic wall. Details of the corrective action for this area are summarized in Section 3.1.7 and presented in Appendix E (In Situ Remediation at Historic Wall Interface, Northern Portion of Building 228 Remedial Unit and Southern Portion of Building 231 Remedial Unit). MACTEC will perform in situ remediation of the southern portion of the RU by injecting a chemical oxidant followed by an oxygen releasing compound in this area to enhance oxidation and biodegradation of residual petroleum-contaminated saturated soils and groundwater in a manner that will not endanger the historic structures (Building 228 and the wall). Figure E-1 of Appendix E shows the injection area, and Figure E-2 shows a cross-section of the injection area.

Building 231 RU: Prior to excavating the Building 231 RU, the Contractor will remove the water line providing fire water service to Building 230 (from west side of the building), the Contractor will provide fire water service from the line installed along the east side of Building 230.

The corrective action implementation for the Building 231 RU is: excavation and offsite disposal of soil; backfilling the excavation with Trust-approved imported fill materials consisting of naturally derived sand and smaller sized fractions; and groundwater monitoring. The Contractor will excavate contaminated soil (including geoarchaeological trench backfill materials) and dispose of excavated material offsite at a Trust-approved disposal facility. Backfilling, grading, and restoration activities are described in Section 3.2.8.

Prior to excavation, under a separate contract, the Trust will demolish Building 231 and remove the existing aboveground soil vapor extraction system equipment located to the southeast of Building 231. The Contractor will then excavate contaminated soil (including geoarchaeological trench backfill materials) and dispose of excavated material offsite at a Trust-approved disposal facility.

Saturated soil is near the ground surface within the vicinity of the historic wall interface based on (1) historical high groundwater elevations measured in shallow groundwater monitoring wells within the Building 231 RU, and (2) reports of groundwater expression in a catch basin within Building 231. The cross-sections shown on Figures 1-3 and 1-4 suggest the top of Bay Mud is between 1.5 feet bgs and 12 feet bgs within the RU.

<u>Excavation of geoarchaeological trench backfill material</u>: The Contractor will excavate, stockpile for characterization, and dispose offsite geoarchaeological trench backfill material from the trench shown on Figure 1-8. Clean soil will not be segregated from impacted soil.

<u>Excavation</u>: The Contractor will excavate Building 231 RU to remove known COCs above cleanup levels until soil confirmation sampling results for all COCs indicate that cleanup levels are met within the excavation bottom as described in Appendix I (Sampling and Analysis Plan for Corrective Actions). The horizontal limits of the excavation are discussed below in Section 2.1.6.

### 2.1.6 Horizontal Limits of Excavations

The Contractor will excavate within the four excavation RUs (Building 230 RU, 38 RU, 207 RU, and 231 RU) to the initial perimeters shown on Figures 2-2A and 2-2B. Sidewall soil confirmation samples will be collected to determine if lateral over-excavation is required to remove COCs above cleanup levels.

The primary remedial action objective of the CAP is to remediate residual petroleum contamination present at the site. Therefore, the guiding premise for potential expansion of the excavations based on confirmation sampling results will be to proceed laterally to remove petroleum-contaminated soil present at concentrations above cleanup levels.

In some areas where structural constraints preclude the ability to expand excavations to remove non-petroleum-related COCs in soils (such as removing roadways to access soil containing metals and PAHs that are not typically associated with petroleum contamination but are likely associated with anthropogenic contamination of fill materials present at the site), a decision may be made in consultation with the Water Board to terminate the excavation if significant petroleum contamination is no longer encountered and any remaining contamination appears to be fill material. If this scenario occurs during excavation activities, a LUC would be implemented to document the residual contamination.

The presence of physical features in portions of the Site or adjacent remediation sites will limit the lateral extent of over-excavation as follows.

Fill Site 6B borders and overlaps with the Building 207/231 Area to the south and east and will constrain excavations. The Trust is currently investigating Fill Site 6B to determine the edges of contaminated fill in the area (*Trust, 2007*). The contaminated fill associated with Fill Site 6B may extend beyond the current Fill Site 6B site boundaries identified on Figure 2-2B. Therefore, for the Building 207/231 Area RUs, the excavations will proceed laterally to remove petroleum-contaminated soil, but will be terminated if significant petroleum contamination is no longer encountered and any remaining contamination appears to be fill material associated with Fill Site 6B. The Fill Site 6B boundaries will be adjusted based on the final Building 207/231 Area excavation limits, as necessary.

During excavation activities, the determination of significant petroleum-contaminated soil associated with Building 207/231 Area releases versus contaminated fill associated with Fill Site 6B will be made by comparing soil confirmation sample data with Fill Site 6B soil data, visual and olfactory evidence, and threat to underlying groundwater quality (i.e., if concentrations exceed Water Board Order cleanup levels for groundwater quality). Based on draft investigation results, the primary contaminants detected in fill soil above cleanup levels at Fill Site 6B to date include metals, PAHs, and pesticides. TPH as motor oil and diesel concentrations have typically ranged from 10 to 250 mg/kg, but have been detected as high as 780 mg/kg in Fill Site 6B soil.

TPH as gasoline has only been detected once at a low concentration and VOCs have not been detected in Fill Site 6B soil (*Trust, 2007*). If sidewall confirmation samples indicate COCs above cleanup levels, the Trust will confer with the Water Board to determine if further excavation is warranted.

If sidewall confirmation samples in Building 207/231 RU excavations indicate COCs are present in soil at concentrations above cleanup levels, the Trust will confer with the Water Board to determine if further excavation is warranted.

The summary of the ranges in concentrations of primary chemicals detected in Fill Site 6B soil borings and test pits (1065TP128, 1065SB114, 1065SB28, 1065SB29, 1065PZ4A, 1065PZ4B, 1065TP127, 1065SB132, 1065HP129, 1065SB120, 1065SB22, and 1065HP29) within 100 feet of the Building 230 RU excavation are (See Corrective Action Plan drawings 6, 7, and 8 for data and sample locations):

-TPH Fuel Oil
    Values range from non detect (ND) to 930 milligrams per kilogram (mg/kg)
-TPH Unknown Diesel
    Values range from ND to 180 mg/kg
-TPH Diesel
    Values range from ND to 200 mg/kg

-PAHs,

Pyrene, values range from non detect (ND) to 0.11 mg/kg;
Anthracene, values range from ND to 0.06 mg/kg;
Benzo(a)anthracene, values range from ND to 0.096 mg/kg;
Benzo(a)pyrene, values range from ND to 0.075 mg/kg;
Benzo(b)fluoranthene values range from ND to 0.17 mg/kg;
Benzo(k)fluoranthene values range from ND to 0.058 mg/kg;
Benzo(g,h,i)perylene values range from ND to 0.13 mg/kg;
Chrysene, values range from ND to 0.23 mg/kg;
Fluoranthene, values range from ND to 0.16 mg/kg;
Phenanthrene, values range from ND to 0.086 mg/kg.

-VOCs

Acetone, values range from ND to 0.06 mg/kg
Carbon Disulfide, values range from ND to 0.00695 mg/kg
2-Butanone, values range from ND to 0.0059 mg/kg
Toluene, values range from ND to 0.001 mg/kg

-Metals

Antimony, values range from ND to 0.67 mg/kg;
Arsenic, values range from 1.6 to 1.8 mg/kg;
Barium, values range from 65 to 690 mg/kg;
Beryllium, values range from 0.16 to 0.48 mg/kg;
Cadmium, values range from 0.32 to 1.9 mg/kg;
Chromium, values range from 62 to 74 mg/kg;
Cobalt, values range from 8 to 9.4 mg/kg;
Copper, values range from 8.5 to 28 mg/kg;
Lead, values range from 2.7 to 590 mg/kg;
Mercury, values range from ND to 0.27 mg/kg;
Molybdenum, values range from ND to 0.43 mg/kg;
Nickel, values range from 40 to 52 mg/kg;
Selenium, values range from ND to 0.64 mg/kg;
Silver, values range from ND to 1.0 mg/kg;
Thallium, values range from ND to 0.58 mg/kg;
Vanadium, values range from 39 to 59 mg/kg;
Zinc, values range from 48 to 970 mg/kg;

The major physical features in the area that will restrict lateral over-excavation include Halleck Street, Mason Street, Marshall Street, the Northern and Southern Doyle Drive overpasses, the historic walls, and Building 230. The technical basis for excavation setbacks and constraints described herein are presented in Appendix K (Geotechnical Recommendations for Excavation Setbacks). In general, the following rules will apply to the excavations to restrict lateral over-excavations at physical features:

- Excavations are not anticipated to proceed underneath Halleck, Mason, or Marshall Streets. Based on soil data collected along the edges of these streets, it is unlikely that contaminated soil extends underneath these roadways. If sidewall soil confirmation samples indicate that significant petroleum-contaminated soil with COCs above cleanup levels extends underneath the roadways,

the Trust will confer with the Water Board to determine if excavation underneath a roadway is warranted. Excavations will not proceed under roadways based solely on soil confirmation samples with metals, PAHs, and other non-petroleum COCs above cleanup levels in excavation sidewalls.

- Excavations will not proceed underneath the Doyle Drive overpasses. A minimum setback of 1 foot to the Doyle Drive overpasses will be maintained so that excavations do not proceed within the right-of-way or beneath the overpass structures. The excavations between the Southern and Northern Doyle Drive overpasses will proceed laterally to remove petroleum-contaminated soil, but will be terminated if significant petroleum contamination is no longer encountered. Any remaining soil with chemicals (e.g., metals and PAHs) above cleanup levels between and underneath the Doyle Drive overpass structures will be addressed by a LUC until Caltrans removes the overpass structures and contaminated soil beneath it is removed during the planned Doyle Drive reconstruction project. The Trust intends to have Caltrans remove impacted soil underneath the Doyle Drive overpasses. Further, if excavation under Gorgas Avenue is deferred until Caltrans begins the Doyle Drive reconstruction project, then a temporary LUC will be placed where corrective actions are deferred.

- A setback distance of 3 feet to the Building 230 foundation will be maintained to protect its structural integrity. If sidewall samples indicate the presence of COCs at concentrations above cleanup levels, the Trust intends to have Caltrans complete the excavation of fill beneath the foundation of Building 230 as part of the Doyle Drive construction project. The Trust will implement a LUC until Building 230 is demolished and contaminated soil beneath the building is removed.

- A setback distance of 5 feet to the historic wall south and west of Building 231 will be maintained; to the extent practicable, excavation with hand equipment (e.g., shovels or with a small backhoe) will be performed adjacent to the 5-foot setback as necessary to remove impacted soils. If confirmation sampling indicates any soil with chemicals of concern above cleanup levels remains adjacent to the historic wall, it will be addressed by a combination of either additional in situ treatment as described above, and/or capping of impacted soils under the LUC for the adjacent Building 228 RU. Details of the corrective action for portion of the RU defined as the “wedge” of soil within the excavation setback (from the wall to approximately 5 feet north of the wall at the surface of the RU, sloping downward to approximately 10 feet north of the wall at the bottom of

the RU, and extending laterally over a span of approximately 30 feet) where excavation can not be implemented without endangering the structural integrity of the historic wall are summarized in Section 3.1.7 and presented in Appendix E (In Situ Remediation at Historic Wall Interface, Northern Portion of Building 228 Remedial Unit and Southern Portion of Building 231 Remedial Unit).

If excavations are terminated before cleanup levels are met, the Contractor will install a visual subsurface marker (such as a permeable geotextile material) to identify the extent of the excavation. Additionally, a licensed land surveyor subcontracted by the Contractor will survey the toe of the excavation limits (to be used to delineate LUC areas).

The following sections present the horizontal limits of the excavations for each specific RU.

#### 2.1.6.1 Excavations South of Doyle Drive (Building 231 RU and Building 230 RU)

The Contractor will excavate within the Building 231 RU and Building 230 RU to the initial perimeters shown on Figure 2-2B. These two excavations are constrained by the Southern Doyle Drive overpass to the north; Fill Site 6B to the north, south, and east; Halleck street to the west; as well as Building 230 and the historic walls.

- Excavation Limits to the North – The Contractor will excavate VOCs and petroleum-contaminated soil above cleanup levels to the north as necessary up to the Southern Doyle Drive overpass. Contaminated soil will remain in place where excavation is not conducted until the eventual Doyle Drive replacement project construction by Caltrans. Although plans are included herein for excavation of the section of Gorgas Avenue within this RU during the planned corrective actions, the Trust also plans to initiate consultation with Caltrans regarding deferral of excavation under Gorgas Avenue until the eventual Doyle Drive replacement project construction. A LUC will be implemented for the portions of the RU where the corrective actions are deferred until excavation is performed during the eventual Doyle Drive replacement project construction. Further, if significant petroleum contamination is no longer encountered and any remaining contamination appears to be fill material associated with Fill Site 6B, the excavation will be terminated.

- Excavation Limits to the South and East – The Contractor will excavate VOCs and significant petroleum-contaminated soil to the south and east as necessary. If significant petroleum

contamination is no longer encountered and any remaining contamination appears to be fill material associated with Fill Site 6B, the excavation will be terminated.

- Excavation Limits to the West – The Contractor will excavate VOCs and significant petroleum-contaminated soil to the west within the Building 231 RU excavation as necessary up to the eastern edge of Halleck Street. Previous data collected along the eastern edge of Halleck Street indicate that the contamination does not likely cross under Halleck Street (i.e., only one sample at MT-1 collected in December 1988 showed benzene above the cleanup level).

- Building 230 – The Contractor will excavate VOCs and significant petroleum-contaminated soil around Building 230 as necessary. However, the Contractor will excavate to within only 3 feet from the Building 230 foundation to protect its structural integrity.

- Historic Wall – For the southwestern edge of the Building 231 RU excavation, an excavation setback of 5 feet to the historic wall will be maintained; to the extent practicable, excavation with hand equipment (e.g., shovels or with a small backhoe) will be performed adjacent to the 5-foot setback as necessary to remove impacted soils. In addition, as described above, the corrective action for portion of the RU defined as the "wedge" of soil within the excavation setback (from the wall to approximately 5 feet north of the wall at the surface of the RU, sloping downward to approximately 10 feet north of the wall at the bottom of the RU, and extending laterally over a span of approximately 30 feet) where excavation can not be implemented without endangering the structural integrity of the historic wall are summarized in Section 3.1.7 and presented in Appendix E (In Situ Remediation at Historic Wall Interface, Northern Portion of Building 228 Remedial Unit and Southern Portion of Building 231 Remedial Unit).

#### 2.1.6.2 Excavations Between Doyle Drive Overpasses (Portions of Building 207 RU and Building 38 RU)

The Contractor will excavate within the Building 207 RU and Building 38 RU to the initial perimeters shown on Figure 2-2A. These two excavations between the Doyle Drive overpasses are constrained by the Northern Doyle Drive overpass to the north; Southern Doyle Drive overpass to the south; Marshall Street to the east; and Halleck Street to the west.

- Excavation Limits to the North and South – The Contractor will excavate significant petroleum-contaminated soil as necessary to the north and south up to the Doyle Drive overpasses. If significant petroleum contamination is no longer encountered, the Contractor will terminate the

excavations before Doyle Drive. (Any remaining soil with COCs (e.g., metals and PAHs) above cleanup levels between and underneath the Doyle Drive overpass structures will be addressed by a LUC until Caltrans removes the overpass structures and the contaminated soil beneath it is removed during the planned Doyle Drive reconstruction project).

- Excavation Limits to the West and East – The Contractor will excavate significant petroleum-contaminated soil as necessary to the west and east up to the edges of Halleck and Marshall Streets, respectively. If significant petroleum contamination is no longer encountered, the Contractor will terminate the excavations before the roadways.

#### 2.1.6.3 Excavations North of Doyle Drive Overpasses (Portions of Building 207 RU and Building 38 RU)

The Contractor will excavate within the Building 207 RU and Building 38 RU to the initial perimeters shown on Figure 2-2A. These two excavations north of Doyle Drive are constrained by Mason Street to the north; the Northern Doyle Drive overpass to the south; Marshall Street to the east; and Halleck Street to the west.

- Excavation Limits to the North – The Contractor will excavate contaminated soil as necessary to the north up to the southern edge of Mason Street. If cleanup levels for all COCs are achieved, the Contractor will terminate the excavations before Mason Street. Previous data collected in this area indicate that the contamination does not likely cross under Mason Street. For the area directly north of the Building 207 RU, the Army previously excavated under Mason Street; therefore, contaminated soil does not cross under Mason Street at this RU.

- Excavation Limits to the South – The two excavations are constrained by the Northern Doyle Drive overpass to the south. The Contractor will excavate contaminated soil to the south as necessary up to the Northern Doyle Drive overpass. If cleanup levels for all COCs are achieved, the Contractor will terminate the excavations before Doyle Drive.

- Excavation Limits to the North and South – The Contractor will excavate significant petroleum-contaminated soil as necessary to the north and south up to the Doyle Drive overpasses. If significant petroleum contamination is no longer encountered, the Contractor will terminate the excavations before Doyle Drive. (Any remaining soil with COCs (e.g., metals and PAHs) above cleanup levels between and underneath the Doyle Drive overpass structures will be addressed by

a LUC until Caltrans removes the overpass structures and the contaminated soil beneath it is removed during the planned Doyle Drive reconstruction project).

- Excavation Limits to the West and East – The Contractor will excavate contaminated soil as necessary to the west and east up to the edges of Halleck and Marshall Streets, respectively. If cleanup levels for all COCs are achieved, the Contractor will terminate the excavations before the roadways.

### 2.1.7 Pre- and Post-Construction Groundwater Monitoring

The approved corrective action for the Building 207/231 Area consists of groundwater monitoring for arsenic, petroleum related constituents, and other RU related COCs for the site-wide monitoring well network that includes downgradient wells in the vicinity of each RU. T&R performed pre- and will perform post- construction groundwater monitoring using a network of upgradient, crossgradient, and downgradient wells for COCs during the pre-construction and post-construction phases of the project (see Figure 1-8 for well locations).

Groundwater monitoring will continue in a monitoring well until all COCs are consistently below cleanup levels for four consecutive monitoring events to (1) verify that contaminant concentrations are decreasing, and (2) that contaminants in groundwater are not migrating offsite. After all concentrations of petroleum-related COCs and arsenic in groundwater have been demonstrated to be below cleanup levels for four consecutive monitoring events in a monitoring well, monitoring will be discontinued in that monitoring well (subject to Water Board approval) and clean closure with regard to groundwater contamination will be documented in a site closure report. 231 GW-09, located upgradient of the RUs, will continue to be monitored until the COC concentrations in all the monitoring wells included in the post-construction groundwater monitoring for the site are below cleanup levels.

A groundwater monitoring plan, which includes a description of the well locations to be monitored, COCs and other parameters that groundwater samples will be analyzed for, frequency of monitoring, and the duration of the monitoring program is presented in Section 3.3.6.

### 2.1.8 Land Use Controls

The Trust will implement a LUC for residual contamination in soil or groundwater associated with the following RUs that contain concentrations of COCs above cleanup levels, as shown on Figure 1-8:

- The Building 228 RU, including the northern portion of the Soil RU and Groundwater RU located between historic Building 228 and the historic wall, and the southern portion of the Soil RU adjacent to the southeastern corner of Building 228. The portion of the Building 228 LUC associated with the northern portion of the Soil RU and Groundwater RU may be discontinued if post-injection in situ soil and groundwater confirmation sampling and downgradient groundwater monitoring indicates corrective actions have reduced concentrations of RU-related COCs in soil and groundwater below cleanup levels for four consecutive sampling events as described in Section 2.1.7.

- Portions of the Building 38 Soil RU and Building 231 (including Former Building 271) Soil RU that are adjacent to or extend beneath the Doyle Drive overpass structures identified in Sections 2.1.3 and 2.1.5, and shown on Figure 1-8 that will be excavated during the eventual Doyle Drive replacement project construction. In addition, although plans are included herein for excavation of the section of Gorgas Avenue within this RU during the planned corrective actions, the Trust also plans to initiate consultation with Caltrans regarding deferral of excavation under Gorgas Avenue until the eventual Doyle Drive replacement project construction. A LUC will be implemented for the portions of the RU where the corrective actions are deferred until excavation is performed during the eventual Doyle Drive replacement project construction. These LUCs will be discontinued after contaminated soil is excavated.

- Additional temporary LUCs will be implemented, as required, if physical features and/or adjacent remediation sites preclude horizontal expansion of the excavations based on confirmation sampling results, and over-excavation to remove all soil contamination containing concentrations of petroleum-related COCs above cleanup levels can not be removed as described in Section 2.1.6.

- The LUC for all groundwater RUs will be discontinued after groundwater monitoring indicates corrective actions have reduced concentrations of RU-related COCs below cleanup levels for four consecutive sampling events as described in Section 2.1.7.

LUCs refer to administrative restrictions on the potential future use of land based on the levels of contaminants that may be left onsite at concentrations greater than would allow for unrestricted use. The Trust generally does not consider LUCs by themselves to meet the cleanup goals for sites where contaminated materials remain left in-place and potentially exposed. LUCs restrict future site use and future site activities in order to limit exposure to COCs left in place or to ensure the effectiveness of the

selected site remedy. The Building 207/231 RUs are located in Area B of the Presidio. Existing and planned land uses in Area B are directed by the Trust through its comprehensive land use and management plan, the Presidio Trust Management Plan (PTMP) (*Trust, 2002*). LUCs in Area B are managed in accordance with the Trust's LUCMRR (*Trust, 2006a*).

The LUCMRR serves as the Trust's overall implementation and enforcement plan to meet the requirements of State of California requirements and §5.11 of the Consent Agreement (*DTSC, 1999*). The LUCMRR provides the framework for LUC management in Area B and describes the procedures the Trust will use to track, implement and enforce LUCs at remediation sites in Area B where LUCs are part of the selected remedy. For each Site identified as requiring a LUC, MACTEC will assist the Trust, who will prepare a site-specific addendum to the LUCMRR. Each site-specific LUCMRR addendum will include a figure that employs Geographical Information System (GIS) coordinates and depicts the site location and nearby area, and will summarize the site history, the specific COCs encountered at the site, the actions taken to remediate the site, the in-place management system (such as containment), the levels and general locations of COCs remaining at the site that required the implementation of the LUC, and site-specific restrictions for that LUC area. The LUC areas will be surveyed during excavation activities to locate the limits of the LUC areas (defined by the toe of the excavation, and/or permanent site features, and/or the limits of the soil RU depicted on Figure 1-8) within each RU.

The site-specific LUCMRR Addendum will be added to the Trust's GIS system that serves as an informational database for all remediation sites with LUCs in Area B of the Presidio. In addition, these site-specific addenda will discuss restricted or prohibited land uses at the site and any special requirements (e.g., health and safety requirements) if the area is disturbed in the future.

As described in Section 5.0, the Construction Completion Report will document the Site-Specific Addendum to the LUCMRR, including all progress reports, implementation reporting communications, data, and records. The site-specific LUCMRR Addendum will be added to the Trust's GIS system that serves as an informational database for all remediation sites with LUCs in Area B of the Presidio, and a copy will be attached to the Construction Completion Report. The LUCMRR identifies the content requirements of site-specific addenda.

# 3.0 CORRECTIVE ACTION IMPLEMENTATION FOR SOIL AND GROUNDWATER

This section describes the pre-construction, construction, and post-construction activities associated with implementing the approved corrective actions outlined in Section 2.0.

The corrective actions will be implemented in conformance with applicable state and federal laws and regulatory requirements including the requirements of Title 23, Division 3, Chapter 16, Article 11, which are the primary regulations establishing the requirements and standards for petroleum-related corrective action in the State of California. Applicable regulations and requirements pertain to the protection of park resources, the handling and transportation of wastes, the control of particulate emissions and pollutants, and other construction-related activities.

Implementation of the corrective actions will proceed upon Water Board approval of this Work Plan. The Trust will notify the Water Board, NPS, and DTSC a minimum of two weeks prior to the initiation of the field components of the corrective action implementation. Review processes will be completed before the corrective actions are implemented. The Trust will review relevant aspects of the project in their "N Squared" Group review that combines their respective National Environmental Policy Act (NEPA) and National Historic Preservation Act (NHPA) reviews.

## 3.1 Pre-Construction Activities

This section identifies tasks that have been performed or are to be performed in advance of or in preparation for construction prior to commencement of excavation construction activities and generally in the sequence presented below:

***Pre-Construction Activities To be Implemented in Advance of Excavation Activities***

The following activities are planned to be initiated in advance of excavation activities.

- Installation of New Well Pair, 231GW200A/200B, downgradient of Building 228 RU (completed January, 2008)
- Pre-Construction groundwater monitoring (Quarters 1 and 2, 2008 completed)
- Notifications, permitting, and regulatory approvals
- Demolition of Building 231

- Implementation of Building 228 RU indoor air and cap assessment corrective actions
- Implementation of Building 231 and 228 RU in situ remediation corrective actions at the historic wall interface
- Well abandonment

***Pre-Construction Activities To be Implemented in Preparation of Excavation Activities***

The following activities are planned to be initiated in preparation of excavation activities:

- Project kickoff meeting
- Subsurface utility clearance
- Setup of temporary facilities including fencing, site controls, etc.
- Pre-construction surveying
- Setup of storm water pollution prevention and erosion control measures
- Implementation of the Traffic Control Plan
- Utility decommissioning
- Installation of temporary sanitary sewer connection.

### 3.1.1 Installation of New Monitoring Wells

T&R has installed a new well pair (231GW200A/200B screened in the shallow and intermediate water-bearing zones, respectively) in January 2008. T&R has developed and surveyed the well pair and its location and elevation were recorded by a licensed land surveyor in accordance with survey requirements in Section 3.1.9. The well was sampled twice during the First and Second Quarter of 2008 groundwater monitoring events (see Figure 1-8 for well location). This work was conducted in accordance with MACTEC's Groundwater Monitoring Well Installation Work Plan, dated 23 January 2008. The well pair has been installed to monitor groundwater in the shallow and intermediate groundwater zones downgradient of proposed in situ remediation injection points for the Building 228 RU. Soil boring data collected during installation of 231GW200B, and groundwater monitoring data from both new wells was considered in the remedial design for the historic wall interface (Appendix E) and provides baseline data to assess downgradient groundwater conditions and compare them with post-ORC Advanced™ injection analytical data. A copy of the *Monitoring Well Installation Report, Building 231/207 Area* (*T&R., 2008*) is provided as Attachment E-1 of Appendix E, and includes the well completion diagrams and soil

sampling data; groundwater data from sampling of the wells during Quarters 1 and 2, 2008 events will be presented in the Trust's next Semi-Annual Groundwater Monitoring Report.

The location and elevation of the new well pair was surveyed by a licensed land surveyor in accordance with survey requirements in Section 3.1.9.

### 3.1.2 Pre-Construction Groundwater Monitoring

T&R sampled groundwater from 231GW200A/200B following its development as part of the First Quarter and Second Quarter 2008 groundwater monitoring program for RU-specific groundwater COCs, redox parameters, and field analytes, as well as from 11 existing wells as summarized in Table 2-1. The samples collected from 231GW200A/200B were analyzed on a rush turn around basis in order to provide the new data for consideration in the remedial design for the historic wall interface as soon as possible.

The pre-construction groundwater monitoring was conducted to establish a baseline that will later be used to compare with post-construction COC concentrations in groundwater. In addition, because a groundwater monitoring well was not present within the Building 228 RU to provide reproducible data on groundwater contamination and conditions, data from the newly installed downgradient well pair, 231GW200A/200B, will be evaluated. An evaluation of the COC concentrations in groundwater downgradient of the Building 228 RU collected from the new well pair are not considered to be directly representative of conditions upgradient, but rather indicative of conditions where the new well pair was located within the in situ remediation area of the southern portion of the Building 231 RU at the historic well interface. The data indicated significant contamination was present in the location of the new well pair; therefore, these data were used in the remedial design for in situ remediation of the "wedge" portion of the Building 231 RU that will not be excavated. The ORC Advanced™ injection rate for the Building 228 RU (Appendix E) that was estimated based on previous data collected from the Building 228 RU will not be directly reevaluated at this time based on the new data. However, the downgradient new well data may be considered in the remedial design for the Building 228 RU after the results are available from the first step of treatment for the Building 231 RU with RegenOx™ as described in Section 3.1.7 and Appendix E.

### 3.1.3 Well Abandonment

The Trust will coordinate pre-construction well abandonment after pre-construction groundwater monitoring is completed. Prior to construction, T&R will subcontract a Presidio-experienced driller to abandon existing monitoring wells or piezometers (47 wells/piezometers are planned) in accordance with

the CAP upon regulatory approval. T&R will abandon these wells/piezometers in accordance with the SOPs identified in Appendix F and State of California Water Well Standards and County of San Francisco Department of Environmental Health (County) requirements, with the exception that neat bentonite (versus cement) will be used to backfill the borings within the Quartermaster Reach Marsh restoration area (bounded by Halleck Street to the west and Marshall street to the west). Bentonite is more compatible with planned marsh restoration than cement. Neat cement will be used to backfill the borings outside the footprint of the Quartermaster Reach marsh restoration area. The surface of all borings will be patched with concrete, except in areas to be restored with landscaping. In landscape areas, the borings will be backfilled with bentonite to the surface.

As outlined in Table 2-1 (Groundwater Monitoring and Well Abandonment Program), T&R will abandon the following wells prior to construction and in accordance with the CAP (see Figure 3-1 for wells to be abandoned):

- Forty existing groundwater monitoring wells within the Building 207/231 CAP Area that are not included in Groundwater Monitoring Program required by the CAP, and
- Seven existing groundwater monitoring wells within the Building 207/231 CAP Area that are included only in the Pre-Construction Groundwater Monitoring Program required by the CAP.

### 3.1.4 Notifications, Permits, and Approvals

***Regulatory Approvals:*** Prior to the start of construction, the Trust will receive approval to start the remedial activities from:

- Water Board – The Trust will submit this Work Plan to the Water Board, who is the lead regulatory agency for the Site for their approval of the Work Plan.
- DTSC – The Trust will submit this Work Plan to the DTSC.
- Water Board – The Trust will file a notice of intent and submit the Storm Water Pollution Prevention Plan (SWPPP) that outlines erosion control and storm water pollution prevention measures for review and approval by the Water Board (Appendix A).

***Trust Actions:*** Prior to the start of excavation, the Trust will:

- Issue a Presidio Excavation Permit

- Approve the plan for utility decommissioning, temporary utility reroute, and reinstallation following completion of excavation

- Notify Caltrans at least two weeks prior to the start of demolition and excavation activities, of the project schedule upon regulatory approval of the Work Plan for excavation areas adjacent to the Doyle Drive overpass structures within the Building 207, 231, and 38 RUs

- Review groundwater analytical data to assess potential concentrations and types of COCs in water that will be extracted as a result of dewatering activities in the excavations, and preparing necessary documentation to gain approval for discharge into the sanitary sewer in accordance with the Trust's industrial wastewater permit.

- Complete project review by the Trust's N Squared Group, which is required for Area B sites.

MACTEC and the Trust have initiated contact with the various resource groups that have an interest in the project. This process will continue throughout the pre-mobilization phase. In addition, the Trust will also notify the Water Board of the start date approximately a month before project kick-off.

***Contractor Notifications/Submittals:*** The Contractor will make the following notifications:

- Notify Bay Area Air Quality Management District (BAAQMD) for soil stockpile management and dust control (Contractor).

In addition, the Contractor will provide the following pre-construction submittals to MACTEC for review and approval:

- Construction Schedule;

- Site Health and Safety Plan;

- Decontamination Facilities Layout;

- Hazardous Waste Operations and Emergency Response (HAZWOPER) Qualifications Certificates;

- Acceptance of the Traffic Control Plan outlined in Appendix B of this Work Plan;

- Waste Characterization and Management Plan; and

- Products Data (i.e., for water piping, sanitary sewer piping, storm drain piping, import fill, etc.; see accompanying Construction Documents [*MACTEC, 2008c*] for full list).

### 3.1.5 Project Kickoff Meeting

Prior to Contractor mobilization, a project "kick-off" meeting will be held at the Trust's office at 67 Martinez Street. The Trust, NPS, MACTEC, the Water Board, the RAB, the Golden Gate National Parks Conservancy (GGNPC), neighboring tenants, and the Contractor will attend this meeting. Specific items to be discussed will include the following:

- Project roles and responsibilities of key project personnel;
- Lines of communication to be maintained by project personnel;
- Overview of the scope of work to be executed;
- Notifications required prior to temporary disconnection of service to allow utility decommissioning;
- Pre-construction and Construction Sequencing;
- Traffic control measures to be deployed during construction;
- Health and Safety Protocols; and
- Exposure monitoring to be conducted at the Site.

### 3.1.6 Subsurface Utility Clearance

The Contractor will conduct intrusive activities, such as excavation, under a Trust excavation permit. The Trust will direct management of utilities discovered during construction.

The Trust's utility department has located and marked known utilities in the immediate vicinity of the proposed work to be performed as part of the corrective actions. The Contractor will contact Underground Services Alert (USA) at least 48 hours in advance of intrusive work. The Contractor will also subcontract a private utility locator who will conduct an independent utility clearance to confirm that the locations marked by the Trust's utility department are accurate. The Contractor will review the Construction Drawings included in the Construction Documents accompanying this Work Plan

(*MACTEC, 2008c*), and will notify the Trust of any discrepancies found between the drawings and field conditions.

MACTEC, T&R, and EKI will conduct separate utility surveys as required for their portions of the field work.

### 3.1.7 Corrective Actions at the Historic Wall Interface

The following corrective actions for the Building 228 RU will be performed independent of excavation-related activities for the other RUs, but will be initiated prior to excavation as part of pre-construction activities at the Site.

#### 3.1.7.1 In Situ Remediation at the Historic Wall Interface

The approved corrective action for the portions of the Building 231 RU and Building 228 RU that occur in the southern portion of the Site at the historic wall interface consist of in situ remediation on both sides of the historic wall. New data collected adjacent to the historic wall since the CAP was prepared (within the Building 231 RU and downgradient of the Building 228 RU) indicates concentrations of petroleum hydrocarbons are significantly above previously documented concentrations and/or cleanup levels. Therefore, the CAP Addendum documented the revised corrective action for combined remediation of both portions of the Building 231 and 228 RUs in this area.

Appendix E presents the details of the design basis and procedures to be followed for in situ remediation using direct push technology injection of two different remediation compounds manufactured by Regenesis, Inc. As the first step of the combined approach, samples will be collected and analyzed for COCs from four soil borings, 2 each on the eastern and western sides of the portion of the Building 231 RU defined as the “wedge” of soil within the excavation setback (from the wall to approximately 5 feet north of the wall at the surface of the RU, sloping downward to approximately 10 feet north of the wall at the bottom of the RU, and extending laterally over a span of approximately 30 feet) where excavation can not be implemented without endangering the structural integrity of the historic wall. After data has been analyzed to further evaluate the extent of contamination and potentially revise the design parameters for in situ remediation, a chemical oxidation compound (RegenOx™) will be injected within the Building 231 RU in a series of four injection events over a period of approximately 6 weeks, with the intent of aggressively oxidizing and significantly reducing petroleum hydrocarbon concentrations where they are documented as significantly above cleanup levels in soil and groundwater within this area. After in situ remediation using RegenOx™ is completed within the Building 231 RU, a slower-acting oxygen

releasing compound (ORC Advanced™ ) will then be injected within both the Building 231 and 228 RUs with the intent of stimulating biodegradation of lower-level residual petroleum hydrocarbons and reducing concentrations in the saturated zone of the subsurface below cleanup levels as a final "polishing" step over a period of approximately 12 months. As a contingency, the corrective action may also include injection of RegenOx™ within the Building 228 RU prior to injection of ORC Advanced™, if based on an evaluation of the results of sampling within the Building 231 RegenOx™ injection area and in consultation with Regenesis, Inc. (the manufacturer of both compounds) and the Water Board, it is indicated as a beneficial adjunct to the remediation approach in meeting cleanup levels.

The corrective actions for the historic wall interface also include groundwater monitoring and a LUC for the Building 228 RU and portion of the Building 231 RU that will not be excavated and will undergo in situ remediation. The corrective action for the Building 228 RU also includes inspection of the existing indoor cap (building foundation) and outdoor cap (paved areas) in the northern and southern portions of the RU, and improvements and maintenance, as necessary; and assessment of vapor intrusion to indoor air through the collection of soil gas samples followed by indoor air monitoring for any chemicals reported in the soil gas samples if potentially significant risks to future building occupants are identified.

MACTEC will contract with and oversee a direct push injection subcontractor, who will inject the compounds through overlapping direct push injection points. The RegenOx™ injections will be conducted within the Building 231 RU during four separate events over a period of approximately 6 weeks, followed by one injection event to apply ORC Advanced™ within both the Building 228 and 231 RUs.

- ***In Situ Remediation Design Basis***: Appendix E presents site-specific data and calculations provided by the in situ remediation compound manufacturer for both the RegenOxTM and ORC AdvancedTM products, along with the remedial design assumptions that were used to calculate application rates.

- ***In Situ Remediation Application Procedures***: MACTEC will subcontract with a driller who will drill the injection points with a direct push drill rig. Based on the assumptions presented in Appendix E, in order to provide in-situ treatment throughout the RUs, twelve injection points will be drilled within each of the RUs as shown on Figure E-1 in Appendix E. Each injection point will be drilled throughout the saturated zone of detectable petroleum-related COCs in soil and/or groundwater as shown on Figure E-2 in Appendix E. The in situ remediation compounds will be

mixed using the dry solids in powder form provided by the manufacturer mixed with clean water to form an injectable slurry, and will be injected at the design rates presented in Appendix E.

- ***Post Injection Performance Monitoring:*** As summarized and in accordance with the schedule presented in Table 2-1, T&R will collect groundwater samples and submit them for analysis from the well pair 231GW200A/200B.

Following both injection events, the effectiveness of each of the in situ remediation compounds in creating conditions favorable for biodegradation of petroleum hydrocarbon compounds will be assessed through the groundwater monitoring conducted: (1) within one month after completion of the chemical oxidant RegenOx$^{TM}$ injection, and (2) on a quarterly basis after completion of the ORC Advanced$^{TM}$ injection to track concentration and biodegradation trends, and to verify that:

- DO levels are increasing in the new well relative to pre-injection conditions.
- Fe(III) concentrations are increasing through the reduction in dissolved iron concentrations as Fe (III) is insoluble relative to Fe(II) relative to pre-injection conditions.
- Dissolved manganese concentrations are decreasing (as a result of oxidation from Mn(2+) to the insoluble Mn(4+) relative to pre-injection conditions.
- Dissolved arsenic concentrations are reducing (as a result of the conversion of arsenite to the more oxidized and insoluble form of arsenate) relative to pre-injection conditions.

Based on experience with sites with similar geologic settings, MACTEC expects both compounds (the chemical oxidant RegenOx$^{TM}$ , and the oxygen releasing compound ORC Advanced$^{TM}$ ), to begin releasing oxygen immediately upon introduction into the water column and to continue to release oxygen for a period of approximately 2 months for the initial chemical oxidant RegenOx$^{TM}$ injection, followed by up to 12 months for the ORC Advanced$^{TM}$ injections. Within two years after these compounds are initially injected, the Trust will conduct in situ direct-push technology (DPT) soil confirmation sampling within and outside of the footprint of the RU considering the technical constraints of access due to the presence of existing buildings or other structural constraints. Details regarding the confirmation sampling will be described in an appendix to the Construction Completion Report based on the results of post-construction groundwater monitoring that assesses the effectiveness of the in situ remediation approaches in reducing petroleum-related COCs within the saturated zone.

#### 3.1.7.2 Indoor Air and Cap Assessment at Building 228 RU

The existing foundation slab of Building 228 is serving to limit the intrusion of VOCs from the subsurface into the indoor air of the building. EKI will inspect the foundation and adjacent areas to confirm absence of VOC entry routes into the building. EKI will also conduct soil gas sampling followed by indoor air monitoring for any chemicals reported in the soil gas samples if potentially significant risks to future building occupants are identified, in accordance with Appendix H (Indoor Cap Corrective Action, Building 228 RU).

Based on the building inspection, if improvements are necessary, EKI will conduct these improvements during construction. These improvements may include: (1) sealing the large cracks, if observed, during the indoor cap assessment; and (2) sealing pipe and conduit penetrations, to prevent occupant exposure to potential volatile COCs in the subsurface within the building.

Appendix H describes the specific actions needed to inspect the indoor cap, identify the need for improvements, and conduct the assessment of potential vapor intrusion to indoor air based on soil gas sampling results in accordance with the Department of Toxic Substances Control (DTSC) Guidance (*DTSC, 2004*) at Building 228. Section 5.3, Table 1-3, and Figure 1-9, respectively, present the documentation procedures for the Building 228 Indoor Cap Corrective Action, the project team responsibilities, and scheduling associated with this corrective action.

The results of the investigation and improvements conducted, if necessary, will be included in the Construction Completion Report.

#### 3.1.7.3 Outdoor Cap Inspection at Building 228 RU

The objectives of the Outdoor Cap Inspection are to inspect and document the existing surface outside the footprint of the building. MACTEC will perform this inspection and documentation. The existing outdoor cap over this LUC area consists of pavement. MACTEC's inspection and documentation will include taking photographs and preparing a written description of the existing outdoor cap. However, if during inspection, if it is determined that the outdoor cap requires improvement, MACTEC will consult with the Water Board regarding the need for backfilling holes and/or paving the area surrounding the building and within the designated LUC area. If there is consensus among the project team that physical improvements are necessary, then the Contractor will perform the improvements, and the results will be documented in: (1) the weekly progress reports during construction; (2) the Construction Completion

report; and (3) the Site-Specific Addendum to the *Land Use Control Master Reference Report for the Presidio* (LUCMRR) (*Trust, 2006a*). Section 5.5 and Tables 1-3 and 1-4 and Section 6.0, respectively, present documentation procedures for the outdoor cap inspection, the project team responsibilities, points of contact, and scheduling associated with this corrective action.

### 3.1.8 Temporary Facility Controls

Prior to the start of construction, the Contractor will:

- Mobilize a temporary trailer office (which will require utilities), sanitary facilities for workers, and mobilize equipment storage units;
- Install perimeter fencing around the project work area;
- Install fuel storage facilities with a spill kit;
- Construct stockpile storage staging areas; and
- Establish a truck staging area.

***Mobilize Temporary Trailer Office, Sanitary Facilities, and Equipment Storage Units:*** The Contractor will mobilize sanitary facilities and equipment storage containers (as required) to the Site. Proposed location is shown on Figure 1-2. The Contractor will arrange for sanitary waste to be removed and disposed at an off-site facility in accordance with applicable laws and regulations.

***Install Perimeter Fencing Around Project Work Area:*** The Contractor will install a perimeter fence at the location shown on Figure 1-2, two weeks prior to the start of construction. The temporary fence will be bounded by Buildings 228 and 229 to the south, Halleck Street to the west, Old Mason Street to the north, and Building 230 to the east.

***Install Fuel Storage Facilities with a Spill Kit:*** For refueling, the Contractor will use double wall fuel tanks, which will be located adjacent to the temporary office trailer. The Contractor will:

- Place spill response equipment nearby when transferring fluids
- Place drip pans under vehicles and equipment until repaired
- Clean spilled fluids promptly

- Designate parking spaces for construction equipment to determine sources of leaking equipment
- Repair leaking equipment within 24 hours of leak detection.

***Establish a Truck Staging Area***: The Contractor will stage the trucks along Old Mason Street, either just west of Building 610 or east of Marshall Street (see Figure 1-2 for location).

***Construct Soil Stockpile Staging Areas:*** The Contractor will construct and maintain soil staging facilities for stockpiling of excavated soil. Figure 1-2 shows locations of stockpile staging areas. Soil removed from the excavations may be temporarily stored in the vicinity of the excavations; the temporary volume of stockpiles will be no more than 250 cubic yards. Loaders will transport soil from temporary stockpiles to the soil staging area for truck loading located between the north and south sections of the Doyle Drive overpass (see Figure 1-2 for locations). The Contractor will review weather forecast daily on the web site "http://www.sfgate.com/weather/." On week days, if impending bad weather is projected between the end of the work day and the start of the next work day, the Contractor will ensure that no soil remains outside the footprint of the excavation at the end of each work day; the excavation spoils will be transferred into the stockpile staging area or pushed back to within the excavation. At the end of each workweek regardless of the weather forecast, the Contractor will ensure that no uncovered and unlined soil remains unattended outside the footprint of the excavation.

The Contractor will construct stockpile storage areas by placing a minimum thickness of 20-mil plastic bottom liner on the ground surface, a 10 mil plastic liner on top, and placing weed-free straw wattles around the plastic. A 6-inch thick sand bedding layer will be placed beneath the 20-mil plastic to prevent impacts to underlying fill at the staging areas. Following completion of field activities, the Contractor will remove and dispose off site the sand bedding material and the liners. When material is not being placed or removed, the Contractor will cover the stockpiles with a weighted plastic cover.

Alternatively, the Contractor will be allowed to pre-profile the excavation area and direct haul the excavation spoils into haul trucks for off-site disposal.

### 3.1.9 Pre-Construction Surveying

The Trust's contractors have and/or will subcontract licensed land surveyors to perform surveys, which consist of:

- Horizontal and vertical coordinates of the top of casings of Monitoring Wells 231GW200A/200B.

- Horizontal coordinates of the subsurface soil gas sample locations.
- Horizontal coordinates of the in situ remediation injection points.
- Excavation control points for assumed excavation boundaries, pavement and concrete removal.
- Control points for demolition of asphalt and concrete.
- The surveyor will establish markings and monuments to control the work. Horizontal and vertical survey controls will be as follows:
- Horizontal control for the surveys will be on NAD 27 California State Plan – Zone 3 – U.S. Survey Feet.
- Vertical control for groundwater elevations will be on the PLLW datum; vertical control for other work (besides groundwater elevations) will be on NAVD 88. The PLLW datum is 0.37 feet higher than the NAVD 88.

The tolerances in setting survey stakes, permanent survey monuments, project benchmarks, and construction control markers are as specified below:

| Type of Line or Mark | Horizontal Position | Elevation |
|---|---|---|
| Permanent Survey Monuments, Wells, Sample Locations, Borings, Utilities, And Points on Corner of LUC Polygons | 1 in 10,000 | +0.01 feet |
| Survey Stakes, Project Benchmarks, Construction Control Points | 1 in 2,000 | +0.1 feet |

The Contractor will submit copies of registered site drawings within seven days of completion for each survey required.

### 3.1.10 Storm Water Pollution Prevention and Erosion Control Measures

The Trust has prepared a storm water pollution prevention plan (SWPPP) for the project in accordance with regulatory requirements for construction storm water pollution management. A copy of the SWPPP is presented in Appendix A. The Contractor will employ best management practices (BMPs) to reduce

the sediment load for runoff from the site. Prior to initiating the excavation activities, the Contractor will implement BMPs on site.

Specific practices that will be implemented to reduce the sediment load of storm water runoff from the excavation areas include the installation of storm water control devices (e.g., straw wattles around excavation areas, straw wattles around catch basins within and in the vicinity of the project area, and placement of silt fence fabric under catch basin grates). All straw wattles utilized on the project will be certified as weed free and seed free.

### 3.1.11 Traffic Control Plan

Figure B-2 of Appendix B shows a traffic control plan for use on site during construction. The construction equipment and other appurtenances will be staged within the fenced project area shown on Figure 1-2.

The proposed Transportation Plan shown on Figure B-2 and the Traffic Control and Signage Guide (Appendix B) provides requirements for the Contractor to maintain and protect pedestrians, bicycle and vehicular traffic on affected roads and parking areas during RU construction except as directed by the Trust. The Contractor will protect traveling public from damage to person and property during construction activities.

The Contractor will confirm compliance of the presented traffic control plan.

The following road closure is anticipated:

- Gorgas Avenue – from Halleck Street on the west to Marshall Street on the east.

Additional road closures may be required if excavation proceeds beyond the limits depicted on Figure 2-2A and 2-2B and into adjacent streets. If such road closures are necessary, the Contractor will present a plan to the stakeholders for review, and approval by the Trust.

### 3.1.12 Utility Decommissioning

Several utilities (i.e., water, gas, electrical, telecommunication, sanitary sewer, and storm drain) exist within and in the vicinity of the excavation areas. Additional details for utility decommissioning are included in the accompanying Construction Documents (*MACTEC, 2008c*).

***Water and Gas:*** The Contractor will decommission water and gas lines that traverse through the excavation as follows:

- Close isolation valves on both sides of the excavation areas to eliminate supply into the lines within the limits of the excavations;
- Cut and cap the lines at the limits of the excavations;
- Remove the lines from within the excavations; and
- Open isolation valves previously closed.

***Sewer:*** A 16-inch sewer line that traverses through the Building 231 RU will be removed and the lines extending from the limits of the excavation to the nearest manholes on either side of the excavation will be abandoned in place by inserting grout plugs at the ends. The sewer line will be removed during excavation.

***Storm Drain:*** Drain inlets and shallow storm drain piping that connect the drain inlets to the existing onsite storm drains from within the excavation footprint will be removed by the Contractor. Further, a 20-inch abandoned storm drain line, located within the footprint of the excavation will be removed by the Contractor. The noted storm drain lines will be removed during excavation.

The noted detailed instructions for notification to tenants affected by the utility decommissioning work and the steps to be followed by the Contractor to decommission utilities within the limits of the excavation are presented in the accompanying Construction Documents (*MACTEC, 2008c*).

#### 3.1.13 Temporary Sanitary Sewer Connection

Temporary sewer connection will be provided to reroute sewage around the Site to the main sewer trunk line, located on Edie Road, which is located to the southeast of Building 1029. Detailed instructions to be followed by the Contractor are presented in the accompanying Construction Documents (*MACTEC, 2008c*).

### 3.2 Construction Activities

This section identifies tasks that are to be performed during construction associated with excavation of soil from the RUs. The tasks are presented in the order that they would be performed in the field:

1. Site Clearing
2. Dust Mitigation During Construction
3. Protection of Resources
4. Protection of Existing Utilities
5. Excavation
6. Soil Confirmation Sampling
7. Stockpile Management and Profiling
8. Post Excavation Record Survey
9. Backfilling and Grading
10. Off Haul of Excavation Spoils
11. Utility Replacement.

### 3.2.1 Excavation Sequencing

The following sequence of execution for the RU-specific activities is anticipated to be performed during excavation, that may be refined or revised as described in the Contractor's Excavation Procedures Plan that will detail excavation sequencing:

1. Building 230 RU Excavation
2. Former Building 38 RU Excavation
3. Former Building 207 RU Excavation
    a. Former Building 207 Excavation
    b. Former Building 208 Excavation
4. Former Building 231 RU Excavation.

At the former Building 231 excavation, the Contractor will begin excavating in the area around borings 231GW01 and 231GW112 (which contain PCB above reporting limits), which are located in the southeastern portion of Building 231. Water removed from this area will be handled separately from the remaining extracted groundwater. Once PCB levels in extracted water from this area drop below the threshold level of 1.5 ppb, extracted groundwater from this area will be handled along with the rest of the extracted groundwater from the site.

### 3.2.2 Site Clearing

The Contractor will remove:

- Asphalt, paving, and concrete surface structures within and adjacent to each RU excavation area (Figure 3-2).
- The existing below-ground soil vapor extraction system piping located within the Former Building 231 RU (Figure 3-2).
- The portion of Gorgas Avenue pavement within the Building 231 RU (Figure 3-2) that would be removed in coordination with the Trust to minimize impacts to local traffic (pending results of the Trust's plans to initiate consultation with Caltrans regarding deferral of excavation under Gorgas Avenue until the eventual Doyle Drive replacement project construction, as described in Section 2.1.6.1) (Figure 3-2).

### 3.2.3 Dust Mitigation During Construction

Construction activities such as clearing, excavation, backfilling and grading operations, construction vehicle traffic on unpaved ground, and wind blowing over disturbed soil may generate dust and particulate matter under dry conditions.

The Excavation Contractor will implement dust control measures to eliminate or minimize the generation of dust associated with the earthwork activities, truck traffic onto and off the site, and the effects of wind traversing exposed soil.

Dust control measures at the site will consist of:

- Reducing vehicular speeds within the area of construction;

- Covering or wetting stockpiles of debris, soil, sand or other materials that can be blown by the wind;
- Misting or spraying water while excavating and loading soil while minimizing ponding;
- Providing equipment and staffing for watering of exposed or disturbed soil surfaces sufficient to suppress dust plumes, including weekends and holidays;
- Minimizing drop heights while loading/unloading excavated soil;
- Minimizing the amount of excavated material or demolition wastes stored on site;
- Covering truck beds loaded with excavated soil leaving the Site;
- Sweeping adjacent streets of soil and mud; and
- Suspending earthmoving or other dust-producing activities during periods of high winds, whenever dust control measures do not greatly reduce visible dust plumes.

### 3.2.4 Protection of Resources

The Excavation Contractor will follow the cultural and natural resources and health and safety protocols outlined below during excavation activities.

#### 3.2.4.1 Resource Protection and Safety Protocols

Corrective action implementation will be conducted in accordance with NHPA and NEPA because the Site is in proximity to areas known to be archaeologically sensitive. MACTEC will monitor activities in accordance with the Programmatic Agreement for the Presidio between the Trust and the State Historic Preservation Officer. Work will be performed in consultation with and approval by Trust and NPS historians and archaeologists. If items of archeologically or historically sensitive importance are found or suspected to be present, the Contractor will stop work. Appendix D (Protocols for Archaeological Artifacts) describes procedures to be followed for handling of any archaeological artifacts identified during construction. The Contractor will resume work in these areas following coordination with and approval by Trust and NPS historians and archaeologists.

No natural resources are anticipated to be encountered based on previous investigations conducted at the Site. Cultural resources include two historic walls, Buildings 201, 227, 228, 229, 230, and Gorgas

Avenue. The Trust Project Manager will coordinate the corrective action implementation with Trust and NPS naturalists, historians, and archaeologists regarding sensitive areas that may exist at or near the RUs and consult with the Excavation Contractor regarding appropriate precautions to be taken during the corrective action implementation.

#### 3.2.4.2 Cultural Resources Protection

The Trust and the Contractor will implement measures and work practices to maintain the integrity of the respective historic structures and their surroundings during corrective action implementation. Building 228 (and adjacent Buildings 227, 229, and 201), Building 230, the historic wall adjacent to the southeast corner of Building 201, the wall south of Building 231 and the wall adjacent to Halleck Street (west of Building 231) are historic structures of contributive value to the National Historic Landmark (NHL), and therefore, have been designated to be preserved. The Gorgas Avenue route is an historic structure of contributive value as a NHL, and the Gorgas Avenue connection is designated to be preserved (except for the portion of roadway that may be removed prior to excavation that would be replaced in accordance with cultural resource guidelines). Guidelines for protection of these cultural resources were presented in a memo addressed to Ryan Seelbach, Presidio Trust Project Manager dated October 16, 2006 by Christina Wallace, Trust Historic Compliance Coordinator *(Trust, 2006b*).

The Contractor, MACTEC, and the Trust oversight team will monitor activities that could affect the historic walls or buildings or other important Site features during the corrective action implementation.

A subsurface geoarchaeological survey of the Building 207/231 Area was performed between January 23 and 27, 2006 according to the *Draft Workplan for Subsurface Geoarcheological Survey of the Building 207/231 Area, Presidio of San Francisco, City and County of San Francisco, California* (*ASC, 2005*). Results of the survey were presented in the *Draft Subsurface Geoarchaeological Survey of the Building 207/231 Area, Presidio of San Francisco, City and County of San Francisco, California* (*ASC & MACTEC, 2006*). The goals of the survey were to document the presence or absence of cultural deposits exposed in subsurface survey trenches, and provide an account of the depositional history of the project area. The survey concluded that there is low potential that buried archeological remains are present within the project area and recommended no further archaeological work at this time.

The Trust will be working closely with a Trust archaeologist during excavation of impacted soil to minimize the potential for damaging cultural resources that may be encountered during the work. Appendix D (Protocols for Archaeological Artifacts) presents protocols for management of significant

archaeological or cultural resources discovered during the corrective action implementation have been developed as part of the above-referenced survey.

The Trust Project Manager will coordinate with Trust historians and archeologists during excavation and if items of potential archeological or historically sensitive importance are found or suspected to be present. If potential human remains are identified, work in the vicinity of the discovery will cease and the Trust will contact the San Francisco Coroner's Office (SF Coroner). The SF Coroner will investigate and remove the remains, if appropriate.

The following cultural resource protection guidelines specific to individual RUs are incorporated into the accompanying Construction Documents (*MACTEC, 2008c*).

- **Building 228** (and adjacent Buildings 227, 229, and 201) – No excavation will be performed in the area of Building 228 and the historic wall to the north. Protection will include installation of a high visibility orange construction fence a minimum of three feet from both the building foundation and the south side of the historic wall. Oxygen releasing compound injection performed as part of the corrective action for this area will not occur within the separation area designated by the construction fence. The wall and foundation protection will remain in place until completion of injection activities.

- **Building 230** – As a protection measure, a minimum 3-foot separation will be maintained from the building foundation during asphalt removal, excavation and backfill activities. If confirmation sampling indicates over-excavation will extend under the loading dock, the Construction Manager will consult with the Trust Project Manager regarding excavation methods and preservation of the loading dock structure.

- **Building 231 Area** – The historic walls to the south and west of Building 231 will require in-place protection prior to and during Building 231 demolition and excavation of the Building 231 RU. Protection will include installation of a high visibility orange construction fence along the north face of the south wall and the western wall adjacent to Halleck Street. To the extent practicable, surgical excavation (e.g., with shovels or with a small backhoe) will be conducted to remove soil impacted with COCs above cleanup levels. The wall protection will remain in place until completion of backfilling and grading activities. In addition, excavation of soil from the Building 231 RU north of the historic wall will not be performed within the 5-foot setback from

the surface and 10-foot setback from the bottom of the slope as designated based on the analysis presented in Appendix K (Geotechnical Recommendations For Excavation Setbacks).

#### 3.2.4.3 Natural Resources Protection

The Site is located in an industrial/commercial area of the Presidio containing primarily buildings, associated parking, and paved areas. The majority of the Site (south of the northern edge of the Northern Doyle Drive Overpass) is located within a freshwater ecological protection zone. The area of the Site north of the Northern Doyle Drive Overpass and south of Crissy Marsh is located within a saltwater ecological protection zone. It is not anticipated that any ecologically sensitive areas/plants/animals will be present. If an animal/plant is discovered in the area that may be of ecological importance, the Construction Manager will notify the Trust, and arrange to have one of the Trust's biologists determine if work can continue or if further measures must be undertaken.

#### 3.2.4.4 Project Health and Safety

A Health and Safety Plan (HASP) (also called a Site Safety and Health Plan [SSHP]) will be prepared by each contractor or subcontractor for implementing their scope of work. The HASPs will be developed following Federal and California Occupational Safety and Health Administration (Cal OSHA) guidelines and other local requirements. Contractors will follow their own HASP(s) and will designate an on-site Health and Safety Officer to coordinate emergency response actions and describe emergency response coordination.

At a minimum, each HASP will:

- Present a baseline program for establishing and maintaining a safe working environment during the implementation of the corrective action
- Address the hazards (i.e., job hazard analysis) associated with the soil removal activities
- If relevant, address the reduction of potential hazards for the local public (e.g., fugitive dust, noise, traffic, etc.).

Site visitors will be required to adhere to the Contractor HASP, including restricted site access, log-in sheets for visitors, and appropriate personal protection equipment (e.g., hard hats and safety vests). The Contractor and/or Trust oversight team will communicate health and safety requirements to site visitors as part of the hazard communication required before entry to the site.

### 3.2.5 Protection of Existing Utilities

The Contractor will protect in place the following utilities present within each RU during excavation:

- 72-inch storm drain; and
- Telecommunication lines within the Building 231 and 207 RUs.

The Contractor will:

- Identify the alignment and depth of utilities to be protected prior to construction by potholing.
- Perform an assessment as to whether a utility can be protected in place. If a utility cannot be protected in place, the Contractor will present a plan for removing and replacing the section of utility impeding construction during one of the regular stakeholder meetings for review, and approval by the Trust.

Details for protection of utilities are included in the accompanying Construction Documents.

### 3.2.6 Excavation Activities

This section describes Contractor requirements for excavation activities associated with removal of impacted soil from each RU, including excavation dewatering and waste water management, excavated soil management and disposal, and potential contingency actions.

#### 3.2.6.1 Soil Excavation

The Contractor will locate excavation areas shown on Figure 2-2A and 2-2B in the field during the Contractor's pre-construction topographic survey using stakes, paint and construction tape during the survey. Prior to excavation, MACTEC, the Trust, and the Contractor will hold a site survey staking review meeting to confirm the marked locations of the assumed excavation areas are correct. Surveying will be performed by a State of California Licensed Surveyor as described in Section 3.1.9.

During excavation of impacted soil from the RUs identified in Section 2.1 and shown on Figure 2-2A and 2-2B, approximately 23,000 cubic yards of soil is estimated to be removed. This volume of soil was estimated based on constructability and engineering considerations (e.g., additional soils associated with excavation sloping necessary to achieve removal of all contaminated soils), and is significantly greater than the estimate presented in the CAP that was based on the interpreted footprint of in-place cleanup level exceedance contours. The total volume to be excavated may differ from these estimates depending

on the results of excavation soil confirmation sampling of sidewalls and excavation bottoms within each RU as described in Appendix I (Sampling and Analysis Plan for Corrective Actions).

During excavation of impacted soil, the Contractor will:

- Excavate material within the assumed excavation areas shown on Figures 2-2A and 2-2B. Although the accompanying Construction Documents (MACTEC, 2008c) include excavation areas as shown on Figure 2-2A and 2-2B, the Trust in collaboration with the Water Board (and with participation from other stakeholders) will determine the actual vertical and horizontal extent of the excavations based on confirmation sampling results and the need for over-excavation in order to remove soil cleanup level exceedances. Section 2.1.6 and Appendix I (Sampling and Analysis Plan for Corrective Actions) describe these protocols.

- Remove the backfill material from the geoarchaeological trenches and dispose excavation spoils offsite.

- Remove decommissioned utilities from within the excavation footprint.

- Ensure stability of sidewalls of excavations by maintaining safe sidewall slopes. Sidewall slopes are presented on Figures 2-2A and 2-2B for planning purposes. If the Contractor deems the excavation sidewalls to be stable, excavations with steeper sidewall slopes can be implemented, if required, to remove COC impacted soils.

- Support confirmation sampling performed by MACTEC by working in other parts of the Site during soil confirmation sampling activities in excavated areas. The Trust will consult with MACTEC and the Water Board as described in Sections 4.3 and 4.4, and Appendix I (Sampling and Analysis Plan for Corrective Actions), to determine the final depths and dimensions of each RU excavation based on comparison of confirmation sampling results with cleanup levels described in Table 1-1, as well as field identification of native soil (i.e., Bay Mud). If excavation and confirmation sampling at the bottom of the smear zone interface of any petroleum hydrocarbon contamination indicates concentrations of COCs in samples exceed cleanup levels, the Trust will consult with the Water Board on the approach for addressing residual contamination present below the smear zone.

- Manage wet conditions at the bottom of the excavation due to groundwater seepage by using natural sand. The Contractor may elect to place sand within the bottoms of RU excavations

requiring entry of Contractor equipment, to improve equipment mobility in accordance with the accompanying Construction Document criteria (MACTEC, 2008c). Trust-approved material will be sampled and tested prior to use in accordance with Construction Document criteria for backfill.

- Prepare and implement a Dewatering Plan as required by the Construction Documents in accordance with guidelines outlined in Appendix C (Dewatering Plan), because it is anticipated that groundwater will be encountered during excavation activities and will continually be seeping into the excavations during construction.

- Protect utilities in place (e.g., 72-inch storm drain and telecommunication lines, etc.) and repair any damage to utilities that may occur during construction activities.

- Profile waste in accordance with offsite disposal facility requirements, including filling out and submitting manifests and backup materials (such as certified test results and sampling methods) to the Trust for review.

- Determine the method of offsite disposal based on waste profile results. The Contractor will determine disposal options in consultation with the Trust.

- Surface-clean trucks transporting debris offsite for disposal before leaving the site using dry methods (such as a broom). No wet washing of tires is anticipated.

- Cover truck loads from the point of departure at the site to the disposal landfill. It is unacceptable for waste or potentially contaminated material to be tracked by truck tires offsite. The Contractor will be responsible to keep the streets clean. If the Contractor does not clean the streets in a timely manner, the Trust reserves the right to clean streets of waste caused by trucks leaving the site and bill the Contractor for the cost of street cleaning.

#### 3.2.6.2 Excavation Dewatering

Dewatering may be required during excavation activities. The Contractor will prepare a Groundwater Dewatering Plan according to the accompanying Construction Documents (*MACTEC, 2008c*) for Trust approval. Dewatering will include surface water, groundwater and water associated with tidal influence, seawater and storm water leaking from the 72-inch storm drain traversing the Building 231 RU. The Contractor will pump water from the excavations using trash pumps into high volume storage tanks used

to store pumped water; the tanks will be outfitted with baffles to filter sediments (see Figure 1-2 for location of tanks).

The Contractor's dewatering plan should control surface water and groundwater flowing toward or into the excavation to prevent the sloughing of the excavation sidewalls and/or slopes and to eliminate interference with the orderly progress of excavation.

Although not anticipated based on site investigation data, if hydrocarbon 'free product' is encountered during excavation, the Contractor will use absorbent pads and/or booms to remove free product floating on the groundwater surface prior to diverting or pumping the water into an onsite storage tank(s). The absorbent pads and/or booms will be stored in drums and disposed of as hazardous waste. If large volumes of free product are encountered, a vacuum truck will be used to vacuum up the floating product prior to dewatering, sampling an offsite disposal at a permitted facility.

***PCB Containing Groundwater Discharge***: As discussed in Section 3.2.1, while excavating at the former Building 231 RU, the Contractor will commence excavation in the southeastern portion of Building 231, where PCB above reporting limits have been detected in groundwater. If PCB concentrations exceed 1.5 ppb, water will be discharged in accordance with Section 13285 of Volume II, Construction Documents. Otherwise, it will be handled as outlined below.

***Discharge of Remainder of Groundwater***: The Contractor will coordinate with the Trust's utility department regarding discharge of water generated during dewatering activities to the sanitary sewer. MACTEC will collect water samples to be analyzed in accordance with the Trust's industrial wastewater permit issued by the City of San Francisco Publicly Owned Treatment Works (POTW) to determine if the water meets discharge requirements. If the collected water does not meet POTW discharge requirements (e.g., water with free product), the Contractor will either treat the water until POTW discharge requirements are met, or transport and dispose of the water at a Trust approved off-site facility. Under no circumstances will collected water be diverted or discharged to the Crissy Marsh or the storm drain system. If the sanitary sewer system does not have the capacity to handle additional collected water due to heavy rains, the Contractor will be prepared to dispose of the wastewater off-site at a Trust-approved off-site disposal facility upon direction.

#### 3.2.6.3 Soil Confirmation Sampling

MACTEC will collect soil confirmation samples from excavated areas to document that soil remaining in the excavation does not exceed cleanup levels identified in Table 1-1. The confirmation soil sampling

strategy including procedures, frequency, methods, sample identification and labeling, Quality Assurance/Quality Control (QA/QC), analyses, and data management will be in accordance with the *Presidio-wide Quality Assurance Project Plan* (Presidio-Wide QAPP; *Tetra Tech, 2001*). As excavation is completed in a soil RU, the Contractor will survey the RU excavations and immediate surrounding areas by placing stakes/markers along a 25 foot by 25 foot grid as described in Appendix I (Sampling and Analysis Plan for Corrective Actions) and shown on Figure I-1. The purpose of the survey is to provide accurate field soil sample locations/excavation dimensions. MACTEC will conduct the confirmation sampling at an excavated RU while the Excavation Contractor performs work in other areas of the Site or proceeds to next soil RU for excavation.

Additional excavation ("over-excavation") may be required based on the results of soil confirmation sampling. The Trust will coordinate with the Water Board regarding the excavation progress, results of confirmation samples, and recommendations to over-excavate by holding weekly meetings, or more frequent meetings as needed (See Section 4.4). Confirmation soil sampling and analysis procedures are described below.

<u>Confirmation Soil Sampling Frequency:</u>

Soil samples will be collected from the excavation "bottom" and along the "sidewalls." Bottom sampling will be based on the estimated size of the excavation with a minimum of one sample per 625 square feet (sf) (25 feet by 25 feet). Sidewalls will be sampled at the midpoint of the height of the sidewall (using best professional judgment for biasing sample location to any visible stained soil layers) every 25 feet of its lateral extent or to obtain at least one sample per excavation sidewall. The actual physical dimensions of the excavation will determine the number of bottom and sidewall samples collected. At least one bottom and four sidewall samples will be collected from each excavation.

<u>Confirmation Soil Sampling Methods:</u>

Confirmation soil samples will be collected in accordance with the Presidio-Wide QAPP, specifically SOP No. 001 (*Tetra Tech, 2001*). Soil samples to be analyzed for non-volatile compounds will be collected in clean brass, stainless steel, or butyrate sleeves, covered with Teflon® sheets and plastic end caps, and labeled. Liners will be driven into the sidewall or bottom of each excavation, or into a backhoe bucket containing soil from the target sample location. Samples collected for VOCs will be collected in Encore samplers. For Encore samples, a hand sampler will be driven next to the location of the tube sample. If the soil is composed of pieces of debris, gravel, or very coarse sand that contains void spaces

or if rock clasts or debris fragments are larger than the diameter of the Encore sampler, the Encore sampler will not be used and soil samples collected for VOCs analysis will be collected in the stainless steel tube. Samples will be stored in an ice-cooled chest for transportation to a state certified laboratory under chain-of-custody protocols. Each ice-cooled chest will maintain a sample temperature of 4°Celsius (C; ±2°C). If sample analysis is to be delayed or put on hold, the Encore samples will be frozen in the laboratory to prevent the possible loss of VOCs before analysis.

Sample Identification and Labeling:

A sample label will be attached to each sample container. The label will be completed in indelible ink with the project name and Site number, a unique identification number, date and time collected, initials of the sampler, and analyses required. Prior to initiation of sampling, MACTEC will prepare a sampling and analysis plan, which includes sample IDs for approval by the Trust's database manager. Confirmation sample identification will be conducted in accordance with the Presidio-Wide QAPP. Confirmation samples will be identified as follows:

- Site (Building/Location) number (e.g., 230),
- Sample type (e.g., EX=excavation),
- Sequence number (e.g., 301, 302, 303,…) for confirmation samples, and
- Depth in feet below ground surface (e.g., 4.5).

For example, the 4th confirmation soil sample, collected at 6 feet bgs will be labeled as 230EX304[6]. Prior to commencement of sampling activities, the Construction Manager and Engineering Contractor (MACTEC) will contact the Trust Environmental Database Manager to confirm that soil sample identification numbers utilized during the corrective action implementation are unique to the Presidio.

Quality Assurance/Quality Control (QA/QC) Samples:

The following QA/QC samples will be collected:

- ***Equipment Rinsate Samples***. Equipment rinsate blanks (RBs) will be collected daily by running distilled water over each sampling device used. However, the total number collected will not exceed 10 percent of the total number of primary samples. Per the Presidio-Wide QAPP, equipment rinsate blank identification will be derived by combining the following symbols: the identification number of the sample collected before the blank, the identifier "RB", and a shortened identification of the sample collected after the blank (e.g., a rinsate blank collected

after location collected after location 230EX301 and before 230EX302 would have a designation of 230EX301RB302).

- ***Field Duplicate Samples***. Per the Presidio-Wide QAPP, field duplicate samples will be collected at a frequency of one for every 10 samples of the sample matrix. Field duplicate samples will be labeled DUP plus the date (i.e., DUP100806 would represent a duplicate sample collected on October 8, 2006). If more then one field duplicate is collected on the same date, a suffix (i.e., "-1" or "-2") will be used to maintain unique sample identification numbers. The duplicate sample will be collected adjacent to the primary sample. The top of each sampling sleeve will be marked in the field and the laboratory will be instructed to sample from the top of the sampling sleeves.

- ***Matrix Spike/Matrix Spike Duplicate (MS/MSD) Samples***. Per the Presidio-Wide QAPP, MS/MSD samples will be identified using the primary field sample location identification plus "MS" or "MSD" (i.e., 230EX301MS or 230EX301MSD). One MS/MSD sample will be collected per every 20 samples of the same matrix.

Sample IDs to be used for other types of samples to be collected during the corrective action activities is presented in Appendix I.

Chain-of-Custody Records:

Chain-of-custody records provide an accurate written record that tracks the possession of individual samples from the time of collection in the field until they are accepted at the laboratory. The chain-of-custody record also will be used to document the samples collected and the analysis requested. The Construction Manager and Engineering Contractor will record the following information on the chain-of-custody record: Project name and number; name and signature of sampler; destination of samples (laboratory name); sample identification number; sample location, description, and depth (where applicable); date and time of collection; number and type of containers filled; analysis requested; preservatives used (if applicable); filtering (if applicable); signature of individuals involved in custody transfer (including the date and time of transfer); laboratory purchase order number; air bill number (if applicable); and relevant remarks related to sample analysis (such as samples selected for MS/MSD analysis).

Per the Presidio-Wide QAPP requirements, a copy of the chain-of-custody record will be delivered to the Trust Project Manager as soon as possible after sampling. An example chain-of-custody record is included in Appendix G (Example Field Forms).

Confirmation Soil Sampling Documentation:

Confirmation sample locations will be sketched in the field notes. Confirmation sample locations that meet cleanup levels will be accurately mapped with the limits of the excavation. Soil confirmation sample locations will be surveyed in the field.

For all samples collected at the Site, sample tracking documents will be prepared so that chain-of-custody records can be maintained and sample disposition can be controlled. Sample identification documents will include a Daily Field Log, a sample label, and chain-of-custody records. The Construction Manager and Engineering Contractor (MACTEC) will prepare these records during each sampling activity. Section 4.1 describes the content of the Daily Field Log that will be prepared specific to the project, and a chain-of-custody record is included in Appendix G (Example Field Forms).

Confirmation Soil Sampling Analysis:

All confirmation samples will be analyzed for one or more of the following COCs identified for each of the Soil RUs described in Appendix I (Sampling and Analysis Plan for Corrective Actions)

- PAHs by Environmental Protection Agency (EPA) Method 8270-SIM;
- TPH as gasoline, diesel, and fuel oil by EPA Method 8015 modified and EPA Method 3630A - Silica Gel Cleanup;
- BTEX/MTBE by EPA Method 8015/8021;
- Pesticides and PCBs by EPA Methods 8081 and 8082; and
- Metals (e.g., arsenic, cadmium, chromium, copper, lead, nickel, zinc) (EPA 6000-7000 series).

The goal of the confirmation sampling is to demonstrate removal of soil contamination associated with petroleum-related releases. As described above in Section 2.1.6, portions of the soil RUs may not be over-excavated to meet cleanup levels due to physical structures or the adjacent Fill Site 6B. Therefore, confirmation sampling of excavation bottoms and/or sidewalls in any areas that do not achieve cleanup levels will be conducted to provide a record of potentially remaining contamination.

Data Validation and Data Management:

MACTEC will obtain analytical data directly from the laboratory and will perform a cursory review of the chemical data (EPA Level II validation) and QA/QC data prior to consulting with the Trust and agencies

regarding the need to continue excavation or begin backfilling. The purpose of the cursory review is to identify any significant QC failures or elevated detection limits that would affect decisions regarding whether the data are sufficient to show that COCs are not present in confirmation soil samples at concentrations greater than cleanup levels. Preliminary analytical data will be screened against cleanup levels and cleanup level exceedances identified. Tables of preliminary data will be prepared and presented in regular stakeholder meetings described in Section 4.4.

Level III and Level IV data validation will be performed after hard copies of the raw data packages are received from the laboratory. Validation will be performed and qualifiers will be applied to analytical results in accordance with the Presidio-Wide QAPP, US Environmental Protection Agency Contract Laboratory Program National Functional Guidelines for Organic Data Review, and US Environmental Protection Agency Contract Laboratory Program National Functional Guidelines for Inorganic Data Review. The results of the Level III and Level IV data validation will be presented in the Construction Completion Report.

Pertinent chain of custody information and analytical data (obtained electronically from the laboratory) will be loaded into MACTEC's database and the Presidio's data base. Survey data (northing and easting coordinates) for the confirmation samples and data validation qualifiers will also be loaded into both data bases. Database reports of Level III validated analytical data will be generated from MACTEC's database for presentation in the Construction Completion Report.

#### 3.2.6.4 Building 230 HydroPunch Sampling

MACTEC will collect groundwater samples from the intermediate sand underlying the Bay Mud following completion of excavation and prior to backfilling the Building 230 RU. Two borings will be drilled, one at the northern limit, and one at the southern limit of the excavation prior to backfilling, and one HydroPunch sample will be collected from each boring; the samples will be analyzed for the COCs listed in Table 1-1 for RU-specific soil COCs (see Figure 2-2B for locations). If adjustments to the locations are warranted, the rationale for the adjustments and the adjusted locations will be presented to the Water Board for approval at a stakeholder meeting.

If COC concentrations are reported above cleanup levels in these samples, the Trust in consultation with the Water Board, will collect additional samples from the intermediate sands.

#### 3.2.6.5 Stockpile Management and Profiling

Figure 1-2 depicts the location of the stockpile staging area. The Contractor will manage the stockpiles in accordance with Section 3.1.8.

For profiling, the Contractor will:

- Profile soil for disposal as described below:
    - The Trust will provide the Contractor soil analytical data from excavation confirmation samples;
    - The Contractor will collect additional samples from stockpiles as required by the landfill to profile the soil for disposal with each soil sample uniquely identified in accordance with Trust sample designation guidelines;
    - Chemicals of concern (COCs) and associated analytical methods identified in one or more of the RUs include the following:
        - Total petroleum hydrocarbon as gasoline (TPHg) by EPA Method 8015 modified;
        - Total petroleum hydrocarbon as diesel (TPHd) and total petroleum hydrocarbon as fuel oil (TPHfo) by EPA Method 8015 modified, prepared with Silica Gel Cleanup, EPA Method 3630A;
        - BTEX/MTBE by EPA Method 8015/8021;
        - PAHs by EPA Method 8310 or 8270-SIM;
        - Pesticides and PCBs by EPA Methods 8081 and 8082; and
        - Metals (e.g., arsenic, cadmium, chromium, copper, lead, nickel, zinc) (EPA 6000-7000 series).
- Determine the location/method of disposal based on waste profile results and approval from the Trust. All material will be disposed or recycled offsite.
- Recyclable materials transported offsite will be surface-cleaned using dry methods (such as a broom), and transported and disposed of offsite as appropriate.

- Submit completed manifests profiles and backup materials (e.g., test results and sampling method) to the Trust for review and signature at least five days prior to scheduled loading for offsite disposal.

Alternatively, the Contractor may choose to pre-profile the soils within the planned excavation areas to allow for direct loading onto haul trucks.

#### 3.2.6.6 Soil Off Hauling

The actual volume of soil transported and disposed of offsite will depend on the amount of soil excavated and the results of confirmation sampling. Approximately 23,000 cubic yards of material is estimated to be excavated and will require disposal from the four RUs.

The Contractor may elect to mix soil from all or some of the RUs for disposal or dispose of individual RU soil separately provided disposal facility waste profile requirements are met. All material will be disposed or recycled offsite at a Trust approved disposal facility.

The Contractor will evaluate disposal options at Class 1, 2, or 3 landfills by assessing the mixture of contaminants and associated concentrations measured in the excavated soil. The excavated soil is anticipated to be acceptable at a Class 2 or 3 landfill; no Class 1 material is anticipated based on previous site characterization data.

After soil profiling is completed and the Trust approves a disposal facility, the Contractor will load soil into trucks operated by a licensed, Department of Transportation (DOT)-approved transportation contractor who will transport the material under a non-hazardous bill of lading or hazardous waste manifest (whichever is appropriate) directly to the disposal facility. The disposal facility will provide a certificate of receipt for each load of material as well as a weight receipt. Hauled materials will be fully covered during transport. The Contractor will provide the Trust copies of the certificates of receipt weekly, which will be documented in the Construction Completion Report.

Proposed truck haul routes are shown on Figure B-1 of Appendix B (Truck Haul Routes Plan), and are summarized as follows.

***<u>Truck Entrance</u>***

- Enter the Presidio through the Gorgas Gate or Richardson Slip Ramp
- Follow Gorgas Avenue or Richardson Avenue respectively to the Site

- Turn right on Marshall Street and proceed to the staging area at the corner of Marshall and Mason
- Enter site through gate on a temporary construction fence along Marshall Street

***Truck Exit***

- Loaded trucks will exit the Site east on Gorgas Avenue
- Turn north on Marshall street
- Turn east on Mason Street
- Turn south on Marina Boulevard
- Turn west on Doyle Drive to Highway 101 to offsite disposal facilities.

Alternatively, the trucks can exit the Site from Gorgas Avenue gate using the Bay Bridge (eastbound) outbound routes.

#### 3.2.6.7 Contingency Actions

Although not expected, the following contingency actions have been developed to minimize disruptions in the event they should occur.

USTs and Associated Piping: If excavation uncovers a previously unidentified UST and/or associated piping, the Trust will comply with applicable State and local regulations for UST and/or associated piping removal. The Contractor will stop work in the area and notify the Trust and Construction Manager, but may continue work in other unaffected portions of the Site as appropriate. The Trust will obtain the appropriate removal permit from the County and/or hire an appropriate contractor to remove the UST and/or associated piping, and associated petroleum hydrocarbon-impacted material, under City and County of San Francisco Department of Public Health and San Francisco Fire Department oversight in accordance with standard procedures at the Presidio. The Contractor will resume work in the area upon authorization from the Trust.

Pipelines: In the event that excavation uncovers an unanticipated underground utility pipe, the Contractor will determine if the line is active or inactive. If the line is an active utility, the Contractor will attempt to support the utility during the excavation activities and maintain its integrity. If the line is determined to be inactive, the Contractor will remove the pipeline. If the pipeline is identified as a conduit for petroleum hydrocarbons associated with a UST or if contamination is identified by staining, odor, and/or organic vapor measurement (OVM) readings, the Contractor will remove as much of the pipe as possible as directed by the Trust.

<u>Drums or Other Containers:</u> In the event that excavation uncovers drums or other containers containing liquids, the Contractor will stop work in the area and contact the Trust and Construction Manager, but may continue work in other unaffected portions of the Site as appropriate. If encountered, the Trust or its contractor will handle the drums or containers in accordance with the Site-specific HASP and applicable laws and regulations and will sample their contents. The Trust will coordinate removal and disposal of the drum or other containers.

If the drums or other containers are found to not have contained a hazardous material, the Trust will direct the Contractor to remove the drums in accordance with standard procedures at the Presidio. Drums or other containers removed from the Site will be placed in lab-packs, overfill drum, or other suitable containers for transportation and off-site disposal if necessary.

If the drums or containers contain hazardous materials, the Trust will coordinate their disposal with the Contractor.

<u>Asbestos-Containing Materials:</u> With the exception of some construction materials that may be present in Building 231 that will be demolished prior to excavation, the presence of asbestos containing materials (ACMs) is considered unlikely at the Site. In the event that ACMs are encountered during excavation, the Contractor will stop work in the area and contact the Trust and Construction Manager, but may continue work in other unaffected portions of the Site as appropriate. ACM will be handled in accordance with the Site-specific HASP and all applicable laws and regulations, as well as any applicable requirements of the Presidio’s Asbestos Operation and Maintenance Program (*HES, 2000*). The Trust will coordinate removal of the ACM with an appropriate environmental in accordance with the Presidio’s Asbestos Operation and Maintenance Program.

<u>Unexploded Ordnance:</u> It is unlikely that any unexploded ordnance (UXO) will be found within, or in the vicinity of the Site. However, UXO has been discovered in other unexpected locations within the Presidio. Therefore, construction crews will be advised of this possibility, and guidelines for recognizing UXO will be attached to the project-specific Health and Safety Plan. These guidelines will be consistent with the NPS Golden Gate National Recreation Area (GGNRA) SOPs regarding potential UXO discovery procedures (*GGNRA, 2004*).

If UXO is discovered during the course of the work, the Contractor will cease work in the affected area, remove personnel from the affected area, and contact the Trust and Construction Manager, who in turn

will coordinate a response with Park Dispatch and all other interested parties. The Contractor will resume work only upon authorization from the Trust Project Manager.

### 3.2.7 Excavation Record Survey

After the Trust approves excavation completion and prior to backfilling, the Contractor will perform an excavation record survey for each RU. The survey will include:

- RU excavation elevations at the toe of the excavations and at the top of the excavations;
- Lateral extent of excavation;
- Lines and levels of exposed utilities during excavation;
- Limits of LUCs (see Section 01720, Field Surveys and Controls) within each RU.
- Lines and levels of subsurface structures (e.g., utilities, etc.) encountered during (1) demolition of Building 231 and the above-ground soil vapor extraction (SVE) system equipment adjacent to the building; and (2) excavation activities (including below-ground piping associated with the SVE system that will be removed during excavation).

The survey will be based on the same horizontal and vertical control datums described under Section 3.1.9 used during the pre-construction site survey. The Contractor will use this survey to calculate the volume of soil excavated from each RU.

### 3.2.8 Backfilling and Grading

This section describes backfill and grading procedures and requirements; detailed Contractor specifications are provided in the accompanying Construction Documents (*MACTEC, 2008c*).

#### 3.2.8.1 Backfill Material Specifications

***Import Fill for Soil RU Backfill:*** After the excavation survey is completed and upon Trust approval (with participation from the stakeholders), the Contractor will backfill the excavations with natural sand. This material will be used to backfill to final grade as follows:

1. Building 231 RU, south of Gorgas Avenue (excluding the areas where the asphaltic concrete trail is to be constructed);

2. Building 207 RU to the north of North Doyle Drive; and

3. Building 38 RU portion to the north of North Doyle Drive.

The material will also be used to backfill to the bottom of the Class II aggregate base to be placed below asphalt pavement in areas, which are to be restored to paved finish surface at:

1. Building 230 RU;

2. Gorgas Avenue (depending on the results of the Trust initiating discussions with Caltrans to potentially defer its removal) and Halleck Street sections of Building 231 RU;

3. Building 208 RU; and

4. Building 38 RU portion to the south of North Doyle Drive.

Prior to using the import fill for backfilling:

- The Contractor will identify sand and smaller sized fractions import fill sources (see Section 02300, Part 2 Products, Paragraph 2.01A and referenced Attachment 2 of Volume II, Technical Specifications for grain size specifications).

- Before import fill is brought to the Site, on behalf of the Trust, MACTEC will collect potential import fill material samples for laboratory analysis; the Contractor will submit an import fill certification form to document the physical (sieve analysis) data for the Water Board to review and approve (with participation from the stakeholders).

- The Trust will select an analytical suite consistent with DTSC Information Advisory Clean Imported Fill Material (*DTSC, 2001*) and Water Board Order No. R2-2003-0080, and provide guidance regarding sample collection and QA/QC procedures in accordance with the Presidio-Wide QAPP (*Tetra Tech, 2001*). The Contractor is responsible for collecting the samples and submitting them for analysis.

- On behalf of the Trust, MACTEC will submit samples for analysis at a minimum for TPHg, TPHfo, TPHd, and BTEX using EPA Test Method 8015 and Title 22 metals using EPA Test Method 6010C and EPA Test Method 7471A for mercury. If the proposed backfill material is from an agricultural source, samples will also be analyzed for pesticides and herbicides by EPA

Methods 8081A, 8141A, and 8151A. Additional analyses may be required based on the source of the imported backfill material.

MACTEC will compare chemical concentrations detected in samples of potential backfill to the Site soil cleanup levels and requirements for backfill material specified in the Water Board Order No. R2-2003-0080. The Trust will not accept soil with chemical concentrations above soil cleanup levels or that does not meet the requirements of the Water Board Order No. R2-2003-0080 or DTSC guidelines as backfill material. The Trust in collaboration with NPS will approve material properties of the backfill material prior to its use.

The following compaction criteria will apply for the various types of backfill proposed for use on site:

| **Type of Backfill** | **Soil Type** | **Compaction Criteria** |
|---|---|---|
| Backfill to Final Surface – Building 231 RU (Except Gorgas Avenue), Landscape Portions of Building 38 RU and 207 RU | Natural Sand | No Compactive Effort |
| Backfill to Bottom of Subgrade – Gorgas Avenue and Parking Lot Portions of Building 38 RU, Building 230 RU, and Building 207 RU | Natural Sand | 90% Minimum, 1 test for each 8-inch loose lift, 100 square yards |
| Utility Trench to Surface – Building 231 RU (Except Gorgas Avenue), Landscape Portions of Building 38 RU and 207 RU | Natural Sand | 90% Minimum, 1 test for each 8-inch loose lift, 100 foot of Trench |
| Utility Trench to Bottom of Subgrade – Gorgas Avenue and Parking Lot Portions of Building 38 RU, Building 230 RU, and Building 207 RU | Natural Sand | 90% Minimum, 1 test for each 8-inch loose lift, 100 foot of Trench |
| Subgrade Below Pavement | Class II – Aggregate Base | 95% Minimum, 1 test for 8-inch loose lift, 100 square yards |

#### 3.2.8.2 Final Site Restoration of the RUs

***Building 230 RU, Building 207 RU, and Building 38 RU Portion to the South of Northern Doyle Drive Overpass:*** The Contractor will backfill and grade the surface to match adjacent grades and pre-construction contours, allowing for pavement replacement. Replacement pavement will match pre-construction drainage patterns.

***Building 207 RU and Building 38 RU Portion to the North of Northern Doyle Drive Overpass:*** The Contractor will backfill and grade the surface to match adjacent grades and pre-construction contours, allowing for seeding with Dwarf Tall Fescue grass seed (see Section 02481, Seeding, Volume II, Technical Specifications. Final grades and surface finish will be restored to match pre-construction drainage patterns.

***Building 231 RU to the South of Gorgas Avenue:*** The Trust, NPS, and their resource groups will restore a portion of the Site in a manner that would visually serve to acclimate the public to the appearance of a restored below-grade wetlands. Therefore, the Building 231 RU will be partially backfilled and rough graded to provide a suitable planting area for willows or a similar type of plant.

Building 231 RU backfill will be graded with minimal slope (approximately 0.5 percent) to facilitate maximum storm water infiltration through the sand backfill material, minimize erosion, and provide a suitable surface for the Trust to implement their post-construction site use as a Propagule Planting Area (see Section 3.3.3). Drainage will be provided through the installation of a drain inlet and a storm drain pipe that discharges groundwater that may rise above the final grade (in late winter and early spring based on historic groundwater elevation data) and storm water to an existing 72-inch storm drain that traverses through the Building 231 RU. However, prior to discharging surface expression of groundwater to the storm drain, MACTEC will collect one surface water sample (and one duplicate sample; if and when surface expression of groundwater is observed) and test the sample for the RU-specific COCs (see Section I-4.3 of Appendix I for full list). The samples will be collected using a bailer in accordance with the Trust's Standard Operating Procedure (SOP)-007-Surface Water Sampling.

Figure 2-1 illustrates historical high groundwater elevation data for the shallow groundwater monitoring zone within the Building 231 Area, and shows interpolated high groundwater elevations (for reference purposes) in parts of the RU where there are no monitoring wells. The proposed final grade for the Building 231 RU is shown on Figure 3-3 and cross sections through the Building 231 RU are shown on Figure 3-3. The cross-sectional view is presented on Figure 3-4 (see Appendix J for design basis,

assumptions, and calculations). Note, however, that until the decision of whether or not the surface expression of groundwater can be discharged to the storm drain is made, the drain inlet will be raised to the historic high groundwater elevation to prevent discharge into the storm drain system. If COC levels are below cleanup levels, then the drain inlet will be lowered to grades depicted on Figure 3-3. Otherwise, the RU will be backfilled to the historic high groundwater elevation.

Storm water run-on into this area will be limited through the construction of curbs along Halleck Street (along the western boundary) and Gorgas Avenue (along the Northern Boundary). The existing Building 230 limits the storm run-on from the east, and the historic wall between Building 228 and the Building 231 RU area limits the storm water run-on from the south.

***<u>Gorgas Avenue Portion of Building 231 RU</u>:*** Although plans are included herein for excavation of the section of Gorgas Avenue within this RU during the planned corrective actions, the Trust also plans to initiate consultation with Caltrans regarding deferral of excavation under Gorgas Avenue until the eventual Doyle Drive replacement project construction. A LUC will be implemented for the portions of the RU where the corrective actions are deferred until excavation is performed during the eventual Doyle Drive replacement project construction. If Gorgas Avenue is removed and soil is excavated from this portion of the RU, the Contractor will replace the existing 36-foot wide section of Gorgas Avenue within the RU with a 28-foot wide two-way road, a six-inch high concrete curb, and a five foot wide raised pedestrian trail after excavation activities are complete. The Contractor will build a pedestrian trail along the southern edge of the Gorgas Avenue replacement section from Halleck Street and extend it around the perimeter of the Building 231. New crosswalk striping will be painted where the pedestrian trails meet Halleck Street to the west and Marshall to the west (Figure 3-3).

### 3.2.9 Utility Replacement

The Contractor will replace utilities removed and/or damaged during excavation in accordance with the standards identified in the accompanying Construction Documents (*MACTEC, 2008c*). The utilities that will be replaced following completion of excavation are:

- Water line on Gorgas Avenue to the north west of Building 230 and serving Building 230, located within the Building 231 RU;
- Sanitary sewer line through the Building 231 RU; and

- Storm drain inlet and line to the existing 72-inch storm drain in the Building 231 RU to provide ongoing drainage of the Propagule Growing Area (see Section 3.2.8.2).

- Irrigation lines in the Building 207 RU.

Other utilities, if damaged during construction, will be replaced by the Contractor in accordance with the Trust and NPS requirements. MACTEC will develop the specifications for this work, if required, in consultation with the Trust and the NPS.

## 3.3 Post-Construction Activities

This section identifies general corrective action post-construction activities and sequencing:

- Contractor demobilization

- Post-Construction Contractor Submittals

- Building 231 RU Planting (by Trust)

- Post-Construction Groundwater Monitoring (by T&R)

- Post-Construction Erosion Control Monitoring (by MACTEC)

- In Situ Soil Confirmation Sampling at the historic wall interface (in the northern portion of the Building 228 RU and southern portion of the Building 231 RU) (by MACTEC).

### 3.3.1 Contractor Demobilization

Following completion of construction activities, the Contractor will demobilize from the Site. Final inspection will be conducted by MACTEC, the Trust, and the NPS in accordance with Presidio programmatic agreements.

Prior to demobilization, the Contractor will:

- Remove all temporary structures (e.g., sanitary facilities, office trailers, etc.);

- Place post-construction erosion control measures in areas backfilled with import fill to grade in areas without an AC pavement surface finish.

### 3.3.2 Post-Construction Contractor Submittals

The Contractor will submit all post-construction submittals within 30 days of completion of work. These submittals include the following:

1. Excavation record topographic survey
2. Final grade survey
3. Lines and levels of new utilities installed following excavation
4. Locations of exposed underground utilities and structures
5. As Built Plans, documenting any field changes from the Construction Drawings included in the accompanying Construction Documents (*MACTEC, 2008c*)
6. Geotechnical test reports confirming compliance with compaction criteria.

### 3.3.3 Building 231 RU Planting

Following the restoration of the Building 231 RU (bounded by Gorgas Avenue to the north, Building 230 to the east, the historic wall to the south, and Halleck Street to the west) to the grades shown on Figure 3-3, the Trust will plant willow plants and/or other suitable vegetation. The proposed name for this area is the “Propagule Growing Area”.

### 3.3.4 Post-Construction Erosion Control Monitoring

Following the completion of backfilling, grading, and restoration activities, the straw wattles placed around the drain inlets in paved areas will be removed. In unpaved areas (i.e., Building 271 RU, Building 38 RU to the north of North Doyle Drive, and Building 231 RU to the South of Gorgas Avenue and West of Halleck Street), surface erosion control measures will be deployed until vegetation gets substantially established. The erosion control measures to be placed may include one or more of the following:

1. Loose straw mulch in the backfilled unpaved areas
2. Straw wattles around the backfilled unpaved areas to prevent storm water runoff from entering excavations
3. Biodegradable surface erosion control fabric to be placed on the backfilled unpaved area.

MACTEC will conduct site inspections as required for a period of one year of post-construction monitoring on behalf of the Trust. During the winter season, weekly monitoring is anticipated, and monthly monitoring is anticipated during the remainder of the year.

### 3.3.5 Post-Construction Well Installation and Groundwater Monitoring

T&R will install five new groundwater monitoring wells utilizing a California state licensed geologist and driller in accordance with Water Board requirements. The new wells will be located so that each RU will have one or more wells in a downgradient location. A well pair (231GW200A/200B) was installed during pre-construction activities as described in Section 3.1.1 All seven new wells and the existing wells will be included in the post-construction groundwater monitoring program for the analytical program summarized in Table 2-1, and their locations are shown on Figure 1-8. T&R will monitor the wells to assess post-construction remedy effectiveness and achievement of cleanup levels. Monitoring results will be included in MACTEC's Construction Completion Report as described in Section 5.0.

### 3.3.6 Post ORC Advanced™ Injection Confirmation Sampling at the Historic Wall Interface

As recommended in the CAP and CAP Addendum, and described in Appendix E, approximately two years after the oxygen release product injection has been implemented at the historic wall interface, direct push technology (DPT) will be utilized to collect in situ soil and groundwater samples within the northern portion of the Building 228 RU and southern portion of the Building 231 RU to evaluate the residual concentrations of petroleum-related COCs in soil, as well as arsenic and redox parameters in groundwater. MACTEC will prepare a separate work plan addendum for review and approval by the Water Board prior to implementation as summarized in Section 5.0.

As recommended in the CAP and CAP Addendum, the effectiveness of the in situ injection of ORC Advanced™ in reducing groundwater COCs below cleanup levels will be assessed quarterly under the groundwater monitoring program over a 2-year period following injection. In situ DPT confirmation sampling will then be conducted at 12 locations within these portions of each RU to assess whether concentrations of COCs in soil and groundwater are below cleanup levels. The need for additional injection or implementation of other technologies consistent with mitigating or preventing migration of groundwater containing COCs above cleanup levels will also be assessed. Details regarding the need for, implementation, and duration of these contingencies would be described in a supplemental report based on the results of post-injection groundwater monitoring and DPT confirmation sampling. If sampling

results indicate concentrations of COCs are below cleanup levels, it is assumed that ‘clean closure’ of these portions of the Building 228 and Building 231 RU would be obtained.

# 4.0 CONSTRUCTION DOCUMENTATION

This section describes the documents and protocols that will be used during implementation of the construction aspects of the corrective actions described in this Work Plan.

## 4.1 Daily Logs

A Daily Field Log will be developed specific to the project, and will be maintained by the Construction Manager and Engineering Contractor (MACTEC) during corrective actions activities that will document Site activities, any problems that occur, and corrective measures implemented through the day. An example Daily Field Log is included in Appendix G (Example Field Forms). The Construction Manager and Engineering Contractor will prepare a chronological daily summary report that includes (at a minimum) the following information:

- Date, name of project, and location;
- Weather and Site conditions;
- Onsite personnel and visitors;
- Summary of any meetings conducted and the decisions made during the meetings (separate meeting minutes will be prepared by the Trust);
- Location of daily construction activities, equipment used, and progress made;
- Type, volume, and location (area excavated from and stockpile location) of materials excavated;
- Location of samples collected including excavation areas where the results of soil confirmation samples are above or below cleanup levels;
- Description and quantity of materials received at the Site and the condition in which they were received;
- Description and quantity of materials hauled offsite;
- Identification of construction problems and their solution or disposition; and
- Health and safety considerations.

## 4.2 Photographic Documentation

Photographs will be taken throughout the corrective action implementation activities. Photographs will be filed in chronological order and will be labeled and indexed to note date and time, photographer name, location, orientation, and a brief description. Photographs will cover all aspects of the Site work during pre-construction, construction, and post-construction activities. A blank photograph log is included in Appendix G (Example Field Forms).

## 4.3 Progress Reports

MACTEC will provide weekly construction monitoring progress reports to the Trust during excavation activities. These weekly reports will describe construction work accomplished, work remaining, any schedule variances, and highlight issues that may arise to impede the progress of the project, and will be included as an appendix to the Construction Completion Report described in Section 5.0. More frequent reports will be prepared as necessary to document ongoing data management and decisions made in field.

## 4.4 Meetings

Tailgate meetings will be held at the Site during construction activities and will be attended by MACTEC, the Trust's corrective action contractors performing work at the Site, and other parties as necessary depending on the work to be completed that day. The daily meetings will focus on health and safety issues or concerns, a review of the work performed the previous day, and the work to be performed during the current day.

During the course of the field activities on the project, progress meetings will be held twice a month, or as needed, at the Trust's office and be attended by the Trust, Excavation Contractor, Construction Manager, Engineering Contractor, and other parties (Water Board, NPS, and DTSC) as necessary. The Construction Manager and Engineering Contractor will keep the Trust informed of the progress of the corrective actions, and the Construction Manager will coordinate all work and contractors, under the oversight of MACTEC.

The Trust will communicate the status of the project, confirmation sampling results, recommendations for over-excavation and other project issues to the Water Board. Additional meetings are anticipated to include kick-off meetings, site walks, and one meeting after excavation work is completed. An agenda will be prepared and faxed out the day before each meeting (except for informal meetings) by the Trust. Meeting minutes will be prepared by MACTEC.

# 5.0 REPORTING AND CORRECTIVE ACTION IMPLEMENTATION DOCUMENTATION

This section identifies the reporting mechanisms and documentation involved with each of the corrective action components that will be implemented at the Site. The Trust's contractors are shown in parentheses if known at this time. A Five-Year Status Report will be completed and submitted to the Water Board that summarizes the status of the corrective actions at the five RUs at the Site five years after construction is completed. It is anticipated that the first report will be submitted in 2013.

## 5.1 Groundwater Monitoring Well Abandonment, Installation, and Monitoring

***Contracting—***Groundwater Monitoring and Well Abandonment/Installation Contractor (Treadwell & Rollo, Inc. [T&R]);

***Planning***—This Work Plan;

***Documentation***—Progress reports prepared by the Groundwater Monitoring and Well Abandonment/Installation Contractor for the Trust;

***Closure / Follow Up Reporting—***An appendix to the Construction Completion Report will be prepared using data obtained by the Groundwater Monitoring and Well Abandonment/Installation Contractor that summarizes the groundwater monitoring data, that will also be included in the Trust's *Semi-Annual Groundwater Monitoring Report, Presidio-Wide Quarterly Groundwater Monitoring*. For the new well installed downgradient of the Building 228 RU, MACTEC will obtain pre-construction groundwater data from T&R regarding installation, development, and sampling of the new monitoring well, and will evaluate the data in regard to oxygen releasing compound application decision-making as described in Section 5.1 and Appendix E. MACTEC will prepare the summary of groundwater monitoring data that will be presented in the Construction Completion Report, which will include an evaluation of the groundwater monitoring results. If post-corrective action groundwater data indicate that petroleum-related COC concentrations in groundwater are below cleanup levels, the report will document that ongoing monitoring will be performed as described in the CAP. If post-excavation data indicates petroleum-related COCs in groundwater are above cleanup levels, the report will include (1) an assessment of the need for and/or recommendations regarding potential application of in situ oxygen releasing compound; and (2) a description of follow-up reporting that is determined to be necessary by the Trust and Engineering Contractor (MACTEC) in consultation with the Water Board.

## 5.2 Excavation and Offsite Disposal

***Contracting***—Excavation Contractor procured by the Trust (to be determined);

***Planning and Procurement***—This Work Plan and the accompanying Construction Documents (*MACTEC, 2008c*);

***Documentation***—Progress reports prepared by the MACTEC for the Trust;

***Closure / Follow Up Reporting***—Construction Completion Report prepared MACTEC.

## 5.3 Indoor Air and Cap Assessment at Building 228 RU

***Contracting***—Building 228 RU Indoor Cap Corrective Action Contractor (EKI);

***Planning***—Appendix H of this Work Plan prepared by the Building 228 Indoor Cap Corrective Action Contractor (EKI);

***Documentation***—Progress reports prepared by the Building 228 Indoor Cap Corrective Action Contractor (EKI) for the Trust;

***Closure / Follow Up Reporting***—An appendix to the Construction Completion Report prepared by the Building 228 RU Indoor Cap Corrective Action Contractor (EKI) that documents the results of the work described in the Appendix H of this Work Plan, including all progress reports, implementation reporting communications, data, and records.

## 5.4 In Situ Remediation at Historic Wall Interface

***Contracting***—In Situ Remediation Contractor (MACTEC) for Historic Wall Interface (Buildings 228 RU and 231 RUs);

***Planning***—This Work Plan;

***Documentation***—Progress Reports prepared by the In Situ Remediation Contractor (MACTEC) for the Trust;

***Closure / Follow Up Reporting—***An appendix to the Construction Completion Report prepared by the In Situ Remediation Corrective Action Contractor (MACTEC) that documents the results of the work

described in the Appendix E of this Work Plan, including all progress reports, implementation reporting communications, data, and records; post-injection Work Plan to be prepared for conducting in situ confirmation sampling and effectiveness assessments; and Summary Report following confirmation sampling.

## 5.5 Outdoor Cap Inspection at Building 228 RU

***Contracting***—Building 228 RU Outdoor Cap Inspection Contractor (MACTEC);

***Planning***—This Work Plan;

***Documentation***—A summary report prepared by the Building 228 RU Outdoor Cap Inspection Contractor (MACTEC) for the Trust;

***Closure / Follow Up Reporting—***Construction Completion Report prepared by the Building 228 Outdoor Cap Inspection Contractor (MACTEC) that documents the results of the work, including all progress reports, implementation reporting communications, data, and records.

## 5.6 Land Use Controls

***Contracting***—Land Use Controls Contractor (MACTEC);

***Planning***—This Work Plan;

***Closure / Follow Up Reporting*** —An addendum to the LUCMRR; a copy will be included as an appendix to the Construction Completion Report. LUCs will be implemented as follows: (a) a temporary LUC for soil beneath structures that will be lifted when clean closure is achieved after future site activities remove these structures to access and excavate contaminated soils during the eventual Doyle Drive replacement project construction; (b) a LUC for areas where in situ remediation will be conducted that may be lifted if concentration of COCs are reduced below cleanup levels over time; and (c) a LUC for groundwater that will be lifted when clean closure is achieved after cleanup levels have been met under the post-construction groundwater monitoring program. The Trust will perform a review of protectiveness of LUC corrective actions every five years and prepare a Five-Year LUC Review Report with recommendations.

### 5.7 Construction Completion Report

Upon completion of the corrective actions described in this Work Plan, the Engineering Contractor (MACTEC) will prepare a Construction Completion Report. The Construction Completion report will present an overall project summary and findings, and will include the following items:

- Brief introduction and Site history;
- In situ remediation and capping corrective actions;
- Data and groundwater monitoring results related to the oxygen releasing compound injection at the historic wall interface (northern portion of Building 228 RU and southern portion of Building 231 RU);
- Soil gas sampling results and follow up indoor air monitoring results if collected, and cap inspection if performed and improvement results related to capping and assessment of potential vapor phase intrusion at Building 228 RU;
- Photographs of work showing the sequence of work;
- QA/QC results for the corrective action implementations, and an analysis of any impacts on the collected data; and
- Chemical analyses and reporting (laboratory reports) that comply with the Presidio-Wide QAPP with Level III/IV data validation, data validation reports, and EDDs that comply with Trust's current format.

<u>Groundwater Corrective Actions</u>

- Well abandonment and installation and related survey data (boring logs and monitoring well completion logs for the six new monitoring wells);
- Groundwater monitoring data collected for the project duration (at a minimum, analytical results from the first round of groundwater monitoring from the newly installed groundwater wells and existing wells identified in Table 2-1);
- Photographs of work showing the sequence of work;

- QA/QC results for the corrective action implementations; and
- Chemical analyses and reporting (laboratory reports) that comply with the Presidio-Wide QAPP with Level III/IV data validation, data validation reports, and electronic data deliverables (EDDs) that comply with Trust's current format.

Excavation Corrective Actions

- Material removal procedures including excavation, material segregation, stockpiling, and backfilling;
- Description of observations of excavated materials;
- Equipment utilization;
- Site restoration activities;
- Sampling and laboratory methods and QA/QC procedures; and
- Presentation of the results and Chain of Custody forms for the analytical sampling and analysis of soil and other waste material.

Permits and Inspection Reports

- Survey reports and maps showing pre-construction, excavation record, intermediate backfill (if needed), and final record areas and elevations;
- Drawing(s) showing sample locations;
- Transportation records including bills of lading and hazardous waste manifests;
- Certifications of disposal from disposal facilities;
- Analytical reports of fill materials used to backfill the excavation and location of borrow source; and
- Photographs of work showing the sequence of work.

QA/QC results for the corrective action implementation

- Chemical analyses and reporting (laboratory reports) that comply with the Presidio-Wide QAPP with Level III/IV data validation, data validation reports, and electronic data deliverables (EDDs) that comply with Trust's current format.

Land Use Control Corrective Actions

- A description of proposed LUCs (the Site-specific LUCMRR addendum will be submitted as an appendix to the Construction Completion Report).

# 6.0 PROJECT SCHEDULE

The Trust's contractors shown on Figure 1-9 will sequence corrective action activities and deliverable submittals in a manner that will ensure the corrective actions are implemented in an orderly, efficient, and safe manner and in accordance with: (1) this Work Plan for all corrective action components, and (2) with this Work Plan and the accompanying Construction Documents (*MACTEC, 2008c*) for excavation corrective actions.

For planning purposes, a Construction Schedule was developed and is presented on Figure 6-1 for illustrative purposes, that indicates the general sequence of tasks through the submittal of the Construction Completion Report and review by the Water Board. The start dates shown on Figure 6-1 for the general sequence of tasks coincide with the finalization phase of this Work Plan. However, the construction will be scheduled in general accordance with the Trust's Baseline Master Schedule for construction projects, which the Trust can supply to the Water Board upon request. The Construction Schedule presents major construction milestones and associated sub-tasks. Some items are tentative and may be modified based on the findings of earlier operations, agency/permitting delays, or contingency operations. The Construction Schedule was developed assuming corrective actions for each RU would be implemented individually in a sequential manner, and presents assumptions for a conservative duration for project completion assuming potential over-excavation activities do not significantly increase the limits of excavation. The Contractor may elect to perform corrective actions for multiple RUs concurrently; however, excavations should be completed to avoid the rainy season and wet conditions.

# 7.0 REFERENCES

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TABLES

**Table 1-1. Soil Cleanup Levels**

| | Compilation of Applicable Cleanup Levels | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Petroleum-Related [b] | | Non Petroleum-Related | | | | | Freshwater Protection Zones [g] | | Saltwater Protection Zones [h] | | **Lowest Applicable Cleanup Level [i] (mg/kg)** |
| Chemical [a] | Cleanup Level (mg/kg) | Basis for Cleanup Level | Background [c] (mg/kg) | Human Health (Residential) [d] (mg/kg) | Ecological (Buffer Zone) [e] (mg/kg) | Ecological (Special Status) [e] (mg/kg) | Water Board ESLs [f] (mg/kg) | Sediment Cleanup Level (mg/kg) | Basis for Cleanup Level | Sediment Cleanup Level (mg/kg) | Basis for Cleanup Level | |
| **Total Petroleum Hydrocarbons (TPH)** | | | | | | | | | | | | |
| TPH as gasoline | 100 | Water Quality: <5 feet above water table | -- | -- | -- | -- | -- | 140 | Freshwater POCC | 11.6 | Saltwater POCC | **11.6** |
| TPH as diesel | 115 | Water Quality: <5 feet above water table | -- | -- | -- | -- | -- | 144 | Saltwater POCC | 144 | Saltwater POCC | **115** |
| TPH as fuel oil | 160 | Water Quality: <5 feet above water table | -- | -- | -- | -- | -- | 144 | Saltwater POCC | 144 | Saltwater POCC | **144** |
| TPH Unknown Diesel Hydrocarbon [j] | | | | | | | | | | | | |
| TPH Unknown Gasoline Hydrocarbon [k] | | | | | | | | | | | | |
| **Polynuclear Aromatic Hydrocarbons (PAHs)** | | | | | | | | | | | | |
| Acenaphthene | -- | -- | -- | 2,700 | 40 | 30 | -- | 0.31 | Ecological: Freshwater | 0.32 | Ecological: Marine | **0.31** |
| Acenaphthylene | -- | -- | -- | -- | 40 | 30 | -- | 0.067 | Ecological: Freshwater | 0.34 | Ecological: Marine | **0.067** |
| Anthracene | 308 | Water Quality: <5 feet above water table | -- | 14,000 | 40 | 30 | -- | 0.45 | Ecological: Freshwater | 0.59 | Ecological: Marine | **0.45** |
| Benzo(a)anthracene | 0.43 | Human health: residential | -- | 0.27 | 40 | 30 | -- | 0.54 | Ecological: Freshwater | 0.93 | Ecological: Marine | **0.27** |
| Benzo(a)pyrene | 0.04 | Human health: residential | -- | 0.027 | 40 | 30 | -- | 0.74 | Ecological: Freshwater | 1.0 | Ecological: Marine | **0.027** |
| Benzo(b)fluoranthene | 0.43 | Human health: residential | -- | 0.27 | 40 | 30 | -- | 0.79 | Ecological: Freshwater | 0.79 | Ecological: Freshwater | **0.27** |
| Benzo(b+k)flouranthene, Total | 0.43 | Human health: residential | -- | 0.27 | 40 | 30 | -- | 0.79 | Ecological: Freshwater | 0.79 | Ecological: Freshwater | **0.27** |
| Benzo(g,h,i)perylene | 620 | Human health: residential | -- | -- | 40 | 30 | -- | 0.25 | Ecological: Freshwater | 0.25 | Ecological: Freshwater | **0.25** |
| Benzo(k)fluoranthene | 0.43 | Human health: residential | -- | 0.27 | 40 | 30 | -- | 0.79 | Ecological: Freshwater | 0.79 | Ecological: Freshwater | **0.27** |
| Chrysene | 4.3 | Human health: residential | -- | 2.7 | 40 | 30 | -- | 0.67 | Ecological: Freshwater | 1.6 | Ecological: Marine | **0.67** |
| Dibenzo(a,h)anthracene | -- | -- | -- | 0.078 | 40 | 30 | -- | 0.071 | Ecological: Freshwater | 0.16 | Ecological: Marine | **0.071** |
| Fluoranthene | 316 | Water Quality: <5 feet above water table | -- | 1,800 | 40 | 30 | -- | 1.5 | Ecological: Freshwater | 2.85 | Ecological: Marine | **1.5** |
| Fluorene | 60 | Water Quality: <5 feet above water table | | 1,800 | 40 | 30 | -- | 0.28 | Ecological: Freshwater | 0.28 | Ecological: Marine | **0.28** |
| Indeno(1,2,3-cd)pyrene | -- | -- | -- | 0.27 | 40 | 30 | -- | 0.26 | Ecological: Freshwater | 0.26 | Ecological: Freshwater | **0.26** |
| Naphthalene | 9 | Water Quality: <5 feet above water table | -- | 910 | 40 | 30 | -- | 0.3 | Ecological: Freshwater | 1.1 | Ecological: Marine | **0.3** |
| Phenanthrene | 86 | Water Quality: <5 feet above water table | -- | -- | 40 | 30 | -- | 0.61 | Ecological: Freshwater | 0.87 | Ecological: Marine | **0.61** |
| Pyrene | 241 | Water Quality: <5 feet above water table | -- | 1,400 | 40 | 30 | -- | 0.79 | Ecological: Freshwater | 1.6 | Ecological: Marine | **0.79** |
| *Total Carcinogenic PAHs* | 5.6 | Human health: residential | -- | -- | -- | -- | -- | -- | -- | -- | -- | **5.6** |
| **Metals / Inorganics** | | | | | | | | | | | | |
| Aluminum [l] | -- | -- | -- | 76000 | -- | -- | -- | -- | -- | -- | -- | **76000** |
| Arsenic | -- | -- | 6.2 | 0.36 | 64 | 10 | -- | 19 | Ecological: Freshwater | 39 | Ecological: Marine | **6.2** |
| Barium | -- | -- | 180 | 5,000 | 500 | 320 | -- | 3,100 | Ecological: Freshwater | 3,100 | Ecological: Marine | **320** |
| Beryllium | -- | -- | 0.99 | 140 | 10 | 10 | -- | 7,200 | Ecological: Freshwater | 7,200 | Ecological: Marine | **10** |
| Cadmium | -- | -- | 0.8 | 1.7 | 0.23 | 0.017 | -- | 1.1 | Ecological: Freshwater | 1.6 | Ecological: Marine | **0.8** |
| Calcium | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | **--** |
| Chromium | -- | -- | 140 | 1,200 | 23 | 4 | -- | 140 | Ecological: Freshwater | 140 | Ecological: Marine | **140** |
| Cobalt | -- | -- | 21 | 4,000 | 48 | 20 | -- | 50 | Ecological: Freshwater | 50 | Ecological: Freshwater | **21** |
| Copper | -- | -- | 49 | -- | 120 | 30 | -- | 114 | Ecological: Freshwater | 152 | Ecological: Marine | **49** |
| Cyanide | -- | -- | -- | 1,000 | 13,000 | 6,300 | -- | -- | -- | -- | -- | **1000** |
| Iron [l] | -- | -- | -- | 23000 | -- | -- | -- | -- | -- | -- | -- | **23000** |
| Lead | 50 | Ecological: Terrestrial 0-3 feet bgs (leaded gas) | 7.5 | 400 | 300 | 160 | -- | 82 | Ecological: Freshwater | 132 | Ecological: Marine | **50** |
| Magnesium | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | **--** |
| Manganese [l] | -- | -- | -- | 1800 | -- | -- | -- | -- | -- | -- | -- | **1800** |
| Mercury | -- | -- | 0.2 | 20 | 1.6 | 0.4 | -- | 0.62 | Ecological: Freshwater | 0.43 | Ecological: Marine | **0.4** |
| Nickel | -- | -- | 110 | 1,400 | 71 | 30 | -- | 110 | Ecological: Freshwater | 110 | Ecological: Marine | **110** |
| Potassium | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | **--** |
| Silver | -- | -- | 1.0 | 360 | 2 | 2 | -- | 1.0 | Ecological: Freshwater | 2.4 | Ecological: Marine | **1** |
| Sodium | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | **--** |
| Vanadium | -- | -- | 90 | 650 | 5 | 2 | -- | 90 | Ecological: Freshwater | 90 | Ecological: Marine | **90** |
| Zinc | -- | -- | 60 | 22,000 | 50 | 4 | -- | 230 | Ecological: Freshwater | 214 | Ecological: Marine | **60** |
| **Volatile Organic Compounds (VOCs)** | | | | | | | | | | | | |
| 1,2,4-Trimethylbenzene [l] | -- | -- | -- | 52 | -- | -- | -- | -- | -- | -- | -- | **52** |
| 1,2-Dichlorobenzene [m] | -- | -- | -- | 8.9 | 30 | -- | 1.1 | -- | -- | -- | -- | **1.1** |
| 1,3,5-Trimethylbenzene [l] | -- | -- | -- | 21 | -- | -- | -- | -- | -- | -- | -- | **21** |
| 1,4-Dichlorobenzene | -- | -- | -- | 0.13 | 74 | 20 | -- | 0.35 | Ecological: Freshwater | 0.35 | Ecological: Marine | **0.13** |
| 2-Butanone | -- | -- | -- | 3.8 | 15,000 | 4,200 | -- | -- | -- | -- | -- | **3.8** |
| 2-Hexanone [n] | -- | -- | -- | 120 | -- | -- | 2.8 | -- | -- | -- | -- | **2.8** |
| Acetone | -- | -- | -- | 0.24 | 68,000 | 8,500 | -- | -- | -- | -- | -- | **0.24** |

**Table 1-1. Soil Cleanup Levels**

| | Compilation of Applicable Cleanup Levels | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Petroleum-Related [b] | | Non Petroleum-Related | | | | | Freshwater Protection Zones [g] | | Saltwater Protection Zones [h] | | |
| Chemical [a] | Cleanup Level (mg/kg) | Basis for Cleanup Level | Background [c] (mg/kg) | Human Health (Residential) [d] (mg/kg) | Ecological (Buffer Zone) [e] (mg/kg) | Ecological (Special Status) [e] (mg/kg) | Water Board ESLs [f] (mg/kg) | Sediment Cleanup Level (mg/kg) | Basis for Cleanup Level | Sediment Cleanup Level (mg/kg) | Basis for Cleanup Level | **Lowest Applicable Cleanup Level [i] (mg/kg)** |
| Benzene | 0.005 | Water Quality: <5 feet above water table | -- | -- | -- | -- | -- | 0.79 | Freshwater POCC | 50 | Saltwater POCC | **0.005** |
| Carbon disulfide | -- | -- | -- | 200 | 14,000 | 934 | -- | -- | -- | -- | -- | **200** |
| cis-1,2-Dichloroethene[m] | -- | -- | -- | 1.6 | -- | -- | 0.19 | -- | -- | -- | -- | **0.19** |
| Ethylbenzene | 13 | Water Quality: <5 feet above water table | -- | -- | -- | -- | -- | 15 | Freshwater POCC | 5 | Saltwater POCC | **5** |
| Methyl tertiary butyl ether[m] | -- | -- | -- | 2.0 | -- | -- | 0.023 | -- | -- | 190 | Saltwater POCC | **0.023** |
| Methylene chloride | -- | -- | -- | 0.076 | 17,000 | 459 | -- | -- | -- | -- | -- | **0.076** |
| Tetrachloroethene[m] | -- | -- | -- | 0.087 | -- | -- | 0.7 | -- | -- | -- | -- | **~~0.7~~0.087** |
| Toluene | 1 | Water Quality: <5 feet above water table | -- | -- | -- | -- | -- | 3 | Freshwater POCC | 260 | Saltwater POCC | **1** |
| Trichloroethene[m] | -- | -- | -- | 0.26 | 60 | -- | 0.46 | -- | -- | -- | -- | **0.26** |
| Xylenes | 33 | Water Quality: <5 feet above water table | -- | -- | -- | -- | -- | 5.7 | Freshwater POCC | 22 | Saltwater POCC | **5.7** |
| Xylenes (m&p-) | 33 | Water Quality: <5 feet above water table | -- | -- | -- | -- | -- | 5.7 | Freshwater POCC | 22 | Saltwater POCC | **5.7** |
| Xylenes (o-) | 33 | Water Quality: <5 feet above water table | -- | -- | -- | -- | -- | 5.7 | Freshwater POCC | 22 | Saltwater POCC | **5.7** |
| **Semi-Volatile Organic Compounds (SVOCs)** | | | | | | | | | | | | |
| Bis(2-ethylhexyl)phthalate[m] | -- | -- | -- | 160 | -- | -- | 66 | -- | -- | -- | -- | **66** |
| **Pesticides and PCBs** | | | | | | | | | | | | |
| 4,4-DDD | -- | -- | -- | 2.0 | 0.53 | 0.049 | -- | 0.016 | Ecological: Freshwater | 0.011 | Ecological: Marine | **0.011** |
| Arochlor 1016 | -- | -- | -- | 0.16 | 0.23 | 0.033 | -- | 0.36 | Ecological: Freshwater | 0.10 | Ecological: Marine | **0.033** |

Notes:

| | |
|---|---|
| mg/kg | Milligrams per kilogram. |
| < | Less than. |
| -- | Not available. |
| POCC | Point-of-compliance concentration. |
| ESL | Environmental screening level (*Water Board, 2005*). |

Checked: MS

Approved: RR

Note: Shaded and bold values are lowest applicable cleanup values.

[a] Only chemicals detected in soil at the Building 207/231 Area are listed.

[b] For petroleum-related constituents, the lowest cleanup levels from Table 5 of the Presidio-Wide Cleanup Level Document (*EKI, 2002*; Table 7-6 Revised May, 2006) are presented. These cleanup values were adopted by the Water Board in Order No. R2-2003-0080, Presidio-wide Site Cleanup Requirements (*Water Board, 2003*).

[c] Background cleanup values for Colma soil formation from *EKI, 2002* Table 7-2.

[d] For VOCs, the human health (residential) values listed from *EKI, 2002* incorporate groundwater protection concerns from Table 7-2.

[e] From *EKI, 2002* Table 7-2.

[f] The Water Board ESLs are for chemicals that do not have a Presidio-specific cleanup level established. The values listed are from *Water Board, 2005* Table A-1 for "Groundwater Protection (Soil Leaching).'

[g] Sediment values were used in selection of cleanup levels for protection of freshwater ecological receptors. Freshwater and saltwater POCC values are from the *Development of Freshwater TPH-diesel and TPH-fuel oil Point of Compliance Concentrations* (*BBL, 2004*) Table 2.1, and the Ecological: Freshwater values are from *EKI, 2002 (Table 7-6 Revised May 2006)* Table 7-3 buffer zone ecological cleanup levels for Colma formation and Table 7-5 freshwater aquatic organisms.

[h] Sediment values were used in selection of cleanup levels for protection of saltwater ecological receptors. Saltwater POCC values are from *BBL, 2004* Table 2.1 and *Water Board, 2003* (Board Order) Table 6, and the Ecological: Freshwater values are from *EKI, 2002* Table 7-3 and the Ecological: Saltwater values are from *EKI, 2002* Table 7-4 and from the buffer zone ecological cleanup levels for Colma formation.

[i] Cleanup levels used for comparison are lowest of Human Health, Ecological (Buffer Zone), Ecological (Special Status), Freshwater Protection Zone Cleanup Levels, and Saltwater Protection Zone Cleanup Levels. Background used if higher.

[j] TPH as diesel cleanup level value used.

[k] TPH as gasoline cleanup level value used.

[l] ESLs not available for aluminum, iron, manganese, 1,2,4- and 1,3,5-trimethylbenzene, so United States Environmental Protection Agency Region 9 Preliminary Remediation Goals (*USEPA, 2004*) used for cleanup purposes.

[m] ESLs were applied for these chemicals because they do not have a Presidio-specific cleanup level established. ESL values from *Water Board, 2005* Table A-1.

[n] Chemical 2-hexanone does not have an established cleanup level or ESL, so MIBK was used as a surrogate for 2-hexanone, which was selected based upon similar physical properties and limited toxicity data. ESL values from *Water Board, 2005* Table A-1.

**Table 1-2. Groundwater Cleanup Levels**

| Chemical [a] | Compilation of Applicable Cleanup Levels [b,c] Human Health Drinking Water Cleanup Level (µg/L) | Basis for Cleanup Level | Freshwater Toxicity Cleanup Level (µg/L) | Basis for Cleanup Level | Saltwater Toxicity Cleanup Level [d] (µg/L) | Basis for Cleanup Level | **Lowest Applicable Cleanup Levels[e] (µg/L)** |
|---|---|---|---|---|---|---|---|
| **Total Petroleum Hydrocarbons (TPH)** | | | | | | | |
| TPH as gasoline | 770 | FPALDR | 443 | Water Board Order | 1200 | RWQCB Order | **443** |
| TPH as diesel | 880 | FPALDR | 443 | Water Board Order | 2200 | RWQCB Order | **443** |
| TPH as fuel oil | 1,200 | FPALDR | 443 | Water Board Order | 2200 | RWQCB Order | **443** |
| TPH Unknown Diesel Hydrocarbon[f] | | | | | | | **443** |
| TPH Unknown Gasoline Hydrocarbon[g] | | | | | | | **443** |
| **Polynuclear Aromatic Compounds (PAHs)** | | | | | | | |
| Acenaphthene | -- | -- | 1,200 | CTR | -- | -- | **1,200** |
| Acenaphthylene | -- | -- | -- | -- | -- | -- | **--** |
| Anthracene | 770 | FPALDR | 9,600 | CTR | -- | -- | **770** |
| Benzo(a)anthracene | 0.1 | Proposed MCL | 0.0044 | CTR | -- | -- | **0.0044** |
| Benzo(a)pyrene | 0.2 | Federal MCL | 0.0044 | CTR | -- | -- | **0.0044** |
| Benzo(b)fluoranthene | 0.2 | Proposed MCL | 0.0044 | CTR | -- | -- | **0.0044** |
| Benzo(k)fluoranthene | 2 | FPALDR | 0.0044 | CTR | -- | -- | **0.0044** |
| Benzo(b+k)flouranthene, Total | 0.2 | Proposed MCL | 0.0044 | CTR | -- | -- | **0.0044** |
| Benzo(g,h,i)perylene | --150 | --FPALDR | -- | -- | -- | -- | **--150** |
| Chrysene | 20 | FPALDR | 0.0044 | CTR | -- | -- | **0.0044** |
| Fluoranthene | 300 | FPALDR | 300 | CTR | -- | -- | **300** |
| Fluorene | 300 | FPALDR | 1,300 | CTR | -- | -- | **300** |
| Indeno(1,2,3-cd)pyrene | -- | -- | 0.0044 | CTR | -- | -- | **0.0044** |
| Naphthalene | 300 | FPALDR | -- | -- | -- | -- | **300** |
| Phenanthrene | 230 | FPALDR | -- | -- | -- | -- | **230** |
| Pyrene | 230 | FPALDR | 960 | CTR | -- | -- | **230** |
| Total cPAHs | 26 | FPALDR | 0.031 | Basin Plan | 0.031 | Basin Plan | **0.031** |
| **Metals / Inorganics** | | | | | | | |
| Aluminum | 1,000 | California MCL | -- | -- | -- | -- | **1,000** |
| Arsenic | 10 | Federal MCL | 150 | Basin Plan | 36 | Basin Plan | **10** |
| Barium | 1,000 | California MCL | -- | -- | -- | -- | **1,000** |
| Cadmium | 5 | Federal MCL | 1.1 | Basin Plan | 9.3 | Basin Plan | **1.1** |
| Calcium | -- | -- | -- | -- | -- | -- | **--** |
| Chloride | 250,000 | Secondary MCL | -- | -- | -- | -- | **250,000** |
| Chromium | 50 | California MCL | 180 | CTR | 50 | Basin Plan | **50** |
| Cobalt | 140 | ESL - Human health | 3.0 | ESL - Aquatic life | 3.0 | ESL - Aquatic life | **3** |
| Copper | 1,000 | Secondary MCL | 9 | Basin Plan | 3.1 | CTR | **3.1** |
| Iron | -- | -- | -- | -- | -- | -- | **--** |
| Lead | 15 | Federal MCL | 2.5 | Basin Plan | 8.1 | Basin Plan | **2.5** |
| Magnesium | -- | -- | -- | -- | -- | -- | **--** |
| Manganese | -- | -- | -- | -- | -- | -- | **--** |
| Nickel | 100 | California MCL | 52 | Basin Plan | 8.2 | CTR | **8.2** |
| Nitrate | 10,000 | Federal MCL | -- | -- | -- | -- | **10,000** |
| Potassium | -- | -- | -- | -- | -- | -- | **--** |
| Sodium | -- | -- | -- | -- | -- | -- | **--** |

**Table 1-2. Groundwater Cleanup Levels**

| Chemical [a] | Compilation of Applicable Cleanup Levels [b,c] | | | | | | Lowest Applicable Cleanup Levels[e] (µg/L) |
|---|---|---|---|---|---|---|---|
| | Human Health Drinking Water Cleanup Level (µg/L) | Basis for Cleanup Level | Freshwater Toxicity Cleanup Level (µg/L) | Basis for Cleanup Level | Saltwater Toxicity Cleanup Level [d] (µg/L) | Basis for Cleanup Level | |
| Vanadium | 15 | ESL - Human health | 19 | ESL - Aquatic life | 19 | ESL - Aquatic life | **15** |
| Zinc | 5,000 | Secondary MCL | 120 | Basin Plan | 81 | Basin Plan | **81** |
| **Volatile Organic Compounds (VOCs)** | | | | | | | |
| 1,1,1-Trichloroethane | 200 | Federal MCL | -- | -- | -- | -- | **200** |
| 1,1,2,2-Tetrachloroethane | 1 | California MCL | 420 | ESL - Aquatic life | 420 | ESL - Aquatic life | **1** |
| 1,1,2-Trichloroethane | 5 | California MCL | 4700 | ESL - Aquatic life | 4700 | ESL - Aquatic life | **5** |
| 1,1,-Dichloroethane | 5 | California MCL | 47 | ESL - Aquatic life | 47 | ESL - Aquatic life | **5** |
| 1,2,4-Trimethylbenzene | -- | -- | -- | -- | -- | -- | **--** |
| 1,2-Dichlorobenzene | 600 | California MCL | 14 | ESL - Aquatic life | 14 | ESL - Aquatic life | **14** |
| 1,2-Dichloroethane | 0.5 | California MCL | 0.38 | CTR | -- | -- | **0.38** |
| 1,2-Dichloroethene (cis & trans) | 6 | California MCL | 590 | ESL - Aquatic life | 590 | ESL - Aquatic life | **6** |
| 1,2-Dichloropropane | 5 | California MCL | 1500 | ESL - Aquatic life | 1500 | ESL - Aquatic life | **5** |
| 1,3,5-Trimethylbenzene | -- | -- | -- | -- | -- | -- | **--** |
| 1,3-Dichlorobenzene | 210 | ESL - Human health | 65 | ESL - Aquatic life | 65 | ESL - Aquatic life | **65** |
| 1,4-Dichlorobenzene | 5 | California MCL | 400 | CTR | -- | -- | **5** |
| 2-Butanone | 4,200 | ESL - Human health | 14,000 | ESL - Aquatic life | 14,000 | ESL - Aquatic life | **4,200** |
| Acetone | 6,300 | ESL - Human health | 1500 | ESL - Aquatic life | 1500 | ESL - Aquatic life | **1,500** |
| Benzene | 1 | California MCL | 463 | Water Board Order | 510 | RWQCB Order | **1** |
| Bromoform | 100 | California MCL/ESL - Human health | 3200 | ESL - Aquatic life | 3200 | ESL - Aquatic life | **100** |
| Carbon dioxide | -- | -- | -- | -- | -- | -- | **--** |
| Carbon disulfide | -- | -- | -- | -- | -- | -- | **--** |
| Chlorobenzene | 70 | California MCL | 680 | CTR | -- | -- | **70** |
| Chloroform | 80 | Federal MCL | 620 | ESL - Aquatic life | 620 | ESL - Aquatic life | **80** |
| Chloromethane | 1.3 | ESL - Human health | 3200 | ESL - Aquatic life | 3200 | ESL - Aquatic life | **1.3** |
| cis-1,2-Dichloroethene | 6 | California MCL | 590 | ESL - Aquatic life | 590 | ESL - Aquatic life | **6** |
| Ethane | -- | -- | -- | -- | -- | -- | **--** |
| Ethene | -- | -- | -- | -- | -- | -- | **--** |
| Ethylbenzene | 300 | California MCL | 845 | Water Board Order | 43 | RWQCB Order | **43** |
| Methane | -- | -- | -- | -- | -- | -- | **--** |
| Methyl t-butyl ether | 13 | California MCL | 8000 | ESL - Aquatic life | 4400 | RWQCB Order | **13** |
| Methylene chloride | 5 | Federal MCL | 4.7 | CTR | -- | -- | **4.7** |
| sec-Butylbenzene | -- | -- | -- | -- | -- | -- | **--** |
| Styrene | 100 | California MCL | 100 | ESL - Aquatic life | 100 | ESL - Aquatic life | **100** |
| tert-Butylbenzene | -- | -- | -- | -- | -- | -- | **--** |
| Tetrachloroethene | 5 | Federal MCL | 0.8 | CTR | -- | -- | **0.8** |
| Toluene | 150 | California MCL | 490 | RWQCB Order | 1000 | RWQCB Order | **150** |
| Trichloroethene | 5 | Federal MCL | 2.7 | CTR | -- | -- | **2.7** |
| Trichlorofluoromethane | 150 | California MCL | -- | -- | -- | -- | **150** |
| Vinyl chloride | 0.5 | California MCL | 780 | ESL - Aquatic life | 780 | ESL - Aquatic life | **0.5** |
| Xylenes | 1,750 | California MCL | 318 | Water Board Order | 130 | RWQCB Order | **130** |
| Xylenes (m&p-) | 1,750 | California MCL | 318 | Water Board Order | 130 | RWQCB Order | **130** |
| Xylenes (o-) | 1,750 | California MCL | 318 | Water Board Order | 130 | RWQCB Order | **130** |

**Table 1-2. Groundwater Cleanup Levels**

| Chemical [a] | Compilation of Applicable Cleanup Levels [b,c] | | | | | | Lowest Applicable Cleanup Levels[e] (µg/L) |
|---|---|---|---|---|---|---|---|
| | Human Health Drinking Water Cleanup Level (µg/L) | Basis for Cleanup Level | Freshwater Toxicity Cleanup Level (µg/L) | Basis for Cleanup Level | Saltwater Toxicity Cleanup Level [d] (µg/L) | Basis for Cleanup Level | |
| **Polychlorinated Biphenyls (PCBs)** | | | | | | | |
| Aroclor 1016 | 0.5 | Federal MCL | 0.00017 | CTR | 0.03 | CTR | **0.00017** |

Notes:

| | |
|---|---|
| µg/L | Micrograms per liter. |
| -- | Not available. |
| MCL | Maximum contaminant level. |
| CTR | California Toxics Rule. |
| cPAH | Carcinogenic polycyclic aromatic hydrocarbons. |
| ESL | Environmental screening level (*Water Board, 2005* ). |
| FPALDR | Fuel Product Action Level Development Report (*MW, 1995c* ). |

Note: Shaded and bold values are lowest applicable cleanup values.

[a] Only chemicals detected in groundwater at the Building 207/231 Area are listed.

[b] For chemicals for which Presidio-specific cleanup levels have been developed, the cleanup levels were compiled from the Presidio-Wide Cleanup Level Document ( *EKI, 2002* ; Table 7-6 Revised May, 2006). For human health, these cleanup levels consist of MCLs or risk-based values developed in the FPALDR (*MW, 1995c* ). For freshwater or saltwater toxicity, these cleanup levels consist of Basin Plan values (updated with *Water Board, 2004* : freshwater Table 3-4 and saltwater Table 3-3 from the 4-day average), CTR values, or Water Board Order values (updated with Water Board Order R2-2003-0080 [*Water Board, 2003* ]: freshwater Table 7 and saltwater Table 6).

[c] For chemicals for which Presidio-specific cleanup levels have not been developed, the cleanup levels were compiled from ESLs for human health and for freshwater and saltwater toxicity for protection of aquatic life from *Water Board, 2005* Table F-1a.

[d] Values apply to marine or saltwater environments. See footnote b for source information.

[e] Cleanup levels are lowest of Human Health, Freshwater, and Saltwater Toxicity values.

[f] TPH as diesel cleanup level value used.

[g] TPH as gasoline cleanup level value used.

Checked: MS
Approved: RR

# Table 1-3. Project Team Responsibilities

| **Responsible Party** | **Responsibilities** | | |
|---|---|---|---|
| | **Pre-Excavation** | **During Excavation** | **Post-Excavation** |
| **Presidio Trust (Owner)** | Review Work Plan | Provide Traffic Coordination | Coordinate Groundwater Monitoring and Reporting |
| | Review Contractor Submittals | Review and Approve Contractor Submittals | Review, approve, and submit Construction Completion Report |
| | Attend Site Walk with Contractor and Engineer | Provide Resource Group Coordination with stakeholders | Review, approve, and submit LUCMRR Addendum |
| | Notify Cal Trans, Regulatory Agencies and Resource Groups 2 weeks prior to construction | Conduct regular stakeholder meetings and coordinate field data and decisions | Manage Land Use Control Areas |
| | Solicit and Award Construction Contract | Review and Sign All Manifests | |
| | Obtain Bay Area Air Quality Management District Demolition Permit, Presidio Excavation Permit, and Sanitary Sewer Waste Water Discharge Permit | Communicate with Construction Manager regarding the Trust's coordination of all contractors and subcontractors | |
| | Perform Building 231 Hazardous Material Survey; Identify Contractor (TBD) to Perform Building 231 Hazardous Waste Abatement | | |
| | Conduct Project Review with N-Squared Group | | |
| | Communication with Construction Manager regarding the Trust's coordination of all contractors and subcontractors | | |

## Table 1-3. Project Team Responsibilities

| Responsible Party | Responsibilities | | |
|---|---|---|---|
| | **Pre-Excavation** | **During Excavation** | **Post-Excavation** |
| **Engineering Contractor, Construction Manager, Construction Quality Assurance, Outdoor Cap Inspection Contractor (MACTEC)** | Prepare Work Plan | Provide Construction Monitoring Documentation During Construction Activities | Prepare Construction Completion Report |
| | Prepare Construction Drawings and Technical Specifications for Excavation Activities and Building 228 ORC Injection | Provide Design Clarifications and Revisions as Needed | Prepare Record Documents from Contractor As-Builts |
| | Prepare Building 231 Demolition Plans and Specifications | Provide Construction Management on Behalf of the Trust | Prepare LUCMRR Addendum |
| | Attend Site Walk with Contractor and Trust | Perform Confirmation Sampling and Data Management | Post-ORC Injection Evaluation and reporting |
| | Mark Out Limits of Work for Utility Notification | Perform Wastewater Sampling and Data Management | |
| | Coordinate Topographic Survey | Perform Import Soil Sampling and Data Management | |
| | Identify Existing Utilities | Review and Submit Laboratory Analytical Results to the Trust | |
| | Perform Building 228 Outdoor Inspection for Cap Improvements, Reporting | | |

Table 1-3. Project Team Responsibilities

| **Responsible Party** | **Responsibilities** | | |
|---|---|---|---|
| | **Pre-Excavation** | **During Excavation** | **Post-Excavation** |
| **Excavation Contractor (To be Determined)** | Attend Site Walk with Trust and Engineer | Demolish Building 231 | Prepare All Close-Out Submittals, Final Record Survey, As-Built Drawings |
| | Prepare and Submit Construction Management Plan | Site Preparation and Excavate Soil | |
| | Prepare Environmental Protection Plan | Maintain Working As-Built Drawings for Trust Review | |
| | Submit HAZWOPER Qualification Certificates | Assist Confirmation Soil and Waste Water Sampling Performed by Engineer | |
| | Prepare Health and Safety Plan | Provide all Construction Submittals, including Plans, Shop Drawings and Test Reports | |
| | Prepare Site Plan | Protect the Public, Cultural and Natural Resources | |
| | Prepare Waste Management Plan | Oversee All Contractor Project Activities | |
| | Prepare Traffic Control Plan | Submit Waste Soil Manifests and Backup Documents | |
| | Submit Contractor Contact Information | Implement Construction Documents | |
| | Submit Pre-Construction Survey Information and Drawings to Trust | Perform Waste Soil Profile Sampling | |
| | Prepare Demolition Methods Plan | Submit Waybills and Shipping Documents | |
| | Prepare Excavation and Handling Methods Plan | Identify Potential Import soils | |
| | Prepare Sampling and Analysis Plan | Perform Soil Testing and Classification | |
| | Prepare Dewatering Plan | Perform Post Excavation Record Survey | |
| | Submit Disposal Sites Information and Waste Profiling Forms | Perform Site Restoration | |

# Table 1-3. Project Team Responsibilities

| **Responsible Party** | **Responsibilities** | | |
|---|---|---|---|
| | **Pre-Excavation** | **During Excavation** | **Post-Excavation** |
| **Historic Wall Interface (Portions of Building 228 & 231 RUs) In Situ Sampling, Injection, and DPT Confirmation Sampling (MACTEC)** | Conduct In Situ Sampling and Inject In Situ Remediation Compounds, Survey Injection Points | Prepare Summary Report | Perform Historic Wall Interface In-Situ DPT Confirmation Sampling |
| | | Perform Building 230 In-Situ DPT Confirmation Sampling | |
| **Groundwater Monitoring, Well Abandonment/ Installation (Treadwell & Rollo)** | Prepare Technical Specifications for Well Abandonment / Installation | Sample Wells | Sample Wells |
| | Abandon / Install and Survey Wells, Sample Wells | | Prepare Semi-Annual Report |
| | Review and Submit Laboratory Analytical Results to the Trust; Provide Data to Bldg 228 ORC Injection Contractor | | |
| **Building 228 Indoor Air and Cap Assessment (EKI, Inc.)** | Prepare Work Plan & Technical Specifications for Indoor Air and Cap Assessment | Perform Survey and Soil Gas Sampling, Data Assessment, Indoor Inspection for Cap Improvements, and follow up steps as necessary based on results. | Prepare Summary Report for Inclusion in Construction Completion Report |

# Table 1-3. Project Team Responsibilities

| **Responsible Party** | **Responsibilities** | | |
|---|---|---|---|
| | **Pre-Excavation** | **During Excavation** | **Post-Excavation** |
| **NPS** | Review Work Plan and Participate in Stakeholder Process, Conduct 5X review for proposed wells in Area A | Attend Regular Stakeholder Meetings During Implementation; participate with other stakeholders in field and over-excavation discussions and decision-making process | |
| **Water Board** | Review and Approve Work Plan, Construction Documents (Specifications & Drawings) | Attend Regular Stakeholder Meetings; participate with other stakeholders in field and over-excavation discussions and decision-making process | Review Construction Completion Report |
| **DTSC / RAB** | Participate in Stakeholder Process | Attend Regular Stakeholder Meetings; participate with other stakeholders in field and over-excavation discussions and decision-making process | |

Checked: MS

Approved: RR

Table 1-4. Project Team Points of Contact
Building 207/231 Area Corrective Action Implementation Work Plan
Presidio of San Francisco, California

| Project Team Member | Name and Title | Address | Phone Number/Email Address |
|---|---|---|---|
| **Presidio Trust (Owner)** | Ryan Seelbach<br>Project Manager<br><br>Eileen Fanelli<br>Remediation Program Manager | Presidio Trust<br>P.O. Box 29052<br>San Francisco, CA 94129-0052<br>67 Martinez Street<br>P.O. Box 29052<br>San Francisco, CA 94129-0052 | (415) 561-5082 (Office)<br>RSeelbach@presidiotrust.gov<br><br>(415) 561-4259 (Office)<br>efanelli@presidiotrust.gov |
| **Engineering, Construction Manager, Construction Quality Assurance, Outdoor Cap Inspection, Land Use Control Contractor (MACTEC, Inc.)** | Ramkishore Rao, P.E.<br>Design Task Manager | 600 Grand Avenue, Suite 300<br>Oakland, CA 94610 | (510) 628-3253<br>Rrao@mactec.com |
| **Excavation Contractor (To be Determined)** | | | |
| **Goundwater Monitoring Contractor (Treadwell & Rollo, Inc.)** | Joshua Graber<br>Senior Project Manager | 555 Montgomery Street, Suite 1300<br>San Francisco, CA 94111 | (415) 955-9040<br>jdgraber@treadwellrollo.com |
| **Indoor Inspection/Sampling Contractor (EKI, Inc.)** | Michelle King | 1870 Ogden Drive<br>Burlingame, CA 94010 | (650) 292-9100 |
| **National Park Service (NPS)** | Brian Ullensvang, P.E.<br>Environmental Engineer | Golden Gate National Recreation Area<br>Fort Mason, Building 201<br>San Francisco, CA 94123 | (415) 561-4726<br>Brian_Ullensvang@nps.gov |
| **California Water Quality Control Board (Water Board), San Francisco Bay Region (Lead Agency)** | Agnes Farres | 1515 Clay Street, Suite 1400<br>Oakland, CA 94612 | (510) 622-2401<br>afarres@waterboards.ca.gov |
| **California Department of Toxic Substances Control (DTSC)** | Robert Boggs, P.E. | 700 Heinz Avenue, Suite 200<br>Berkeley, CA 94710-2737 | (510) 540-3751<br>RBOGGS@dtsc.ca.gov |
| **Presidio Trust Utilities Department** | Robert Malaca<br>Utilities Manager | Building 1750<br>Presidio Trust<br>P.O. Box 29052<br>San Francisco, CA 94129-0052 | (415) 561-3924<br>rmalaca@presidiotrust.gov |
| **Presidio Trust and NPS Archeology Contacts** | Sannie Osborn<br>Historic Archeologist<br><br>Leo Barker | Presidio Trust<br>P.O. Box 29052<br>San Francisco, CA 94129-0052 | (415) 561-5090<br>sosborn@presidiotrust.gov<br><br>(415) 561-4832<br>leo_barker@nps.gov |

Checked: MS Approved: RR

Table 2-1. Summary of Groundwater Monitoring and Well Abandonment Program
Corrective Action Implementation Work Plan Building 207/231 Area

| Well Name | Water Bearing Zone | Location With Respect to Remedial Units | Perform Well Abandonment During Construction | PRE-CONSTRUCTION MONITORING PROGRAM [3]<br><br>Frequency and Duration: One-time sampling event at least 2 months prior to start of construction<br><br>Analytes: TPHd/fo (EPA Method 8015); VOCs (EPA Method 8260); As, Al, Mn, Fe (EPA Method 6010)<br><br>Field Analysis: Water levels, pH, specific conductance, dissolved oxygen (DO) | POST-CONSTRUCTION MONITORING PROGRAM [1] [4]<br><br>Frequency:<br>Excavation Alternative (RUs 207, 38, 231, 230)<br>YEAR 1: Quarterly<br>AFTER YEAR 1: As, Al, Mn, Fe Annually and all other analytes and Field Analysis Semi-Annually<br><br>Capping Alternative (RU 228)<br>YEAR 1: Quarterly<br>YEAR 2: As, Al, Mn, Fe Annually and all other analytes and Field Analysis Semi-Annually<br>YEARS 3--10: Annually<br><br>Duration:<br>Monitor As, Al, Mn, Fe until Arsenic concentrations are below cleanup levels.<br>Monitor all other analytes until COCs are below cleanup levels for 4 consecutive monitoring events.<br>Monitoring will cease on a per individual analyte suite (e.g., VOCs) and /or by well basis<br><br>Analytes: See RU-specific list of analytes below<br><br>Field Analysis: Water levels, pH, specific conductance, Dissolved oxygen (well-specific) |
|---|---|---|---|---|---|
| **BUILDING 207 AREA REMEDIAL UNIT** | | | | | |
| 207GW03 | INTERMEDIATE | downgradient of RU 207 | X | | -- |
| New Well 6 | SHALLOW | east/crossgradient of RU 207 | RETAIN | | TPHg (EPA Method 8015)<br>Benzene, MTBE (EPA Method 8021)<br>PAHs (EPA Method 8270-SIM)<br>Nickel (EPA Method 6010) |
| New Well 3 | SHALLOW | downgradient of RU 207 | RETAIN | | TPHg (EPA Method 8015)<br>Benzene, MTBE (EPA Method 8021)<br>PAHs (EPA Method 8270-SIM)<br>Nickel (EPA Method 6010) |
| New Well 4 | SHALLOW | downgradient of RU 207 | RETAIN | | TPHg (EPA Method 8015)<br>Benzene, MTBE (EPA Method 8021)<br>PAHs (EPA Method 8270-SIM)<br>Nickel (EPA Method 6010) |
| **BUILDING 231 AREA REMEDIAL UNIT** | | | | | |
| New Well 2 | SHALLOW | downgradient of RU 231 | RETAIN | | TPHg (EPA Method 8015)<br>TPHd,fo (EPA Method 8015 w/SGCU)<br>VOCs [BTEX, MeCl, PCE, VC] (EPA Method 8260)<br>PAHs (EPA Method 8270-SIM)<br>Cr, Co, Cu, Pb, Hg, Ni, Ag, Zn (EPA Method 6010) |
| 231GW06 | INTERMEDIATE | downgradient of RU 231 | X | | |
| 231GW09 | SHALLOW | upgradient of RUs | RETAIN | X | TPHg (EPA Method 8015)<br>TPHd,fo (EPA Method 8015 w/SGCU)<br>VOCs [BTEX, MeCl, PCE, VC] (EPA Method 8260)<br>PAHs (EPA Method 8270-SIM)<br>Cr, Co, Cu, Pb, Hg, Ni, Ag, Zn, As (EPA Method 6010)<br>Redox Parameters |
| 231GW10 | SHALLOW | upgradient of RU 208 sump | X | X | |
| 231GW13 | DEEP | west/cross-gradient of RU 207 | X | | |
| 231GW15 | INTERMEDIATE | west/cross-gradient of RU 207 | X | | |
| 231GW16 | SHALLOW | west/cross-gradient of RU 207 | RETAIN | X | TPHg (EPA Method 8015)<br>TPHd,fo (EPA Method 8015 w/SGCU)<br>VOCs [BTEX, MeCl, PCE, VC] (EPA Method 8260)<br>PAHs (EPA Method 8270-SIM)<br>Cr, Co, Cu, Pb, Hg, Ni, Ag, Zn, As (EPA Method 6010)<br>Redox Parameters |
| 231GW17 | DEEP | west/cross-gradient of RUs | X | | |
| 231GW18 | INTERMEDIATE | west/cross-gradient of RUs | X | | |
| 231GW19 | SHALLOW | west/cross-gradient of RUs | X | | |
| 231GW20 | INTERMEDIATE | downgradient of RU 231 | X | X | |
| 231GW21 | SHALLOW | downgradient of RU 231 | X | X | |
| 231GW22 | SHALLOW | downgradient of RU 231 | X | X | |
| 231GW23 | SHALLOW | upgradient of RUs 207/38 | X | | |
| 231GW24 | SHALLOW | west/cross-gradient of RUs | X | | |
| 231GW25 | SHALLOW | downgradient of RU 231 | RETAIN | X | TPHg (EPA Method 8015)<br>TPHd,fo (EPA Method 8015 w/SGCU)<br>VOCs [BTEX, MeCl, PCE, VC] (EPA Method 8260)<br>PAHs (EPA Method 8270-SIM)<br>Cr, Co, Cu, Pb, Hg, Ni, Ag, Zn, As (EPA Method 6010)<br>Redox Parameters |

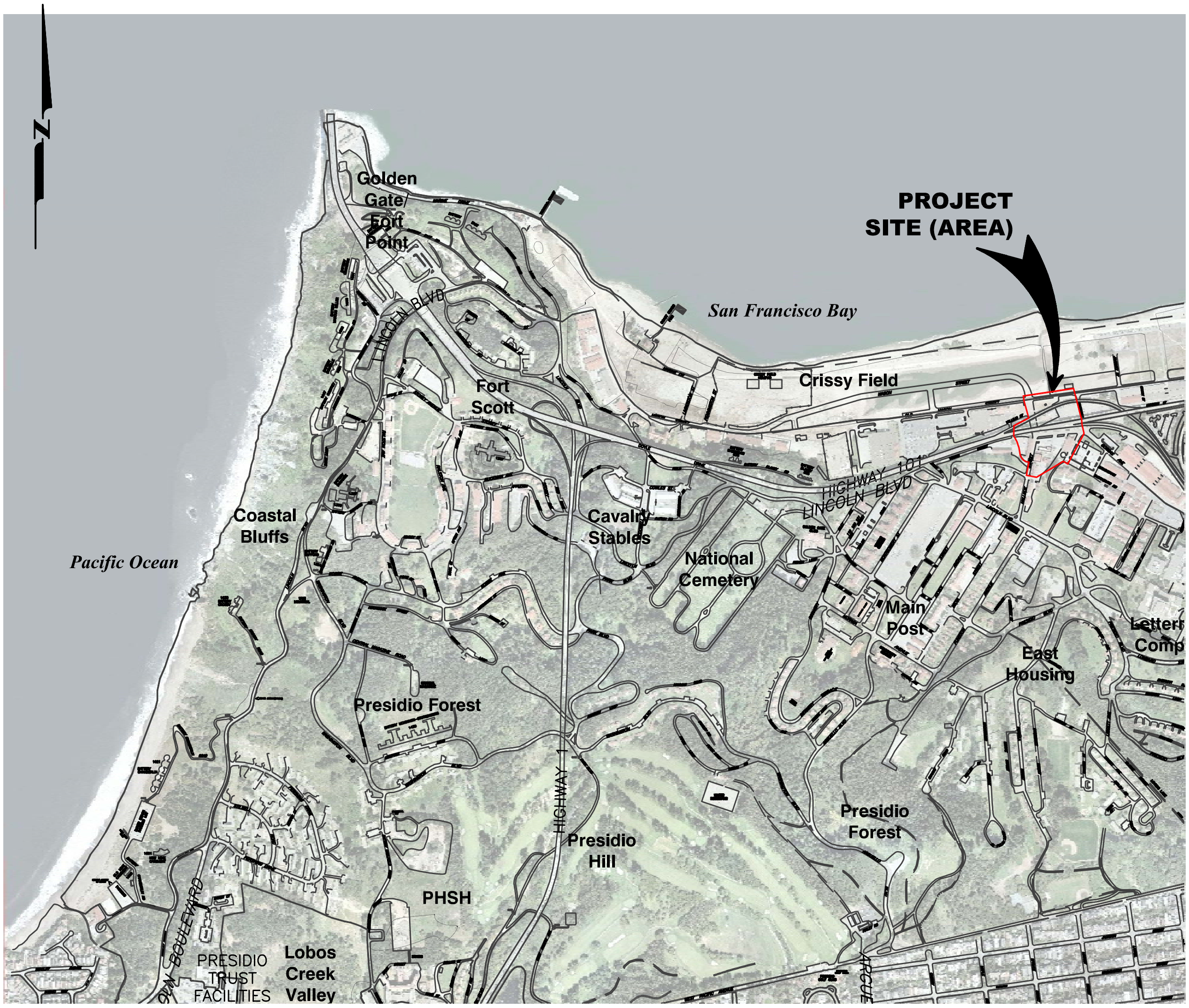
Table 2-1. Summary of Groundwater Monitoring and Well Abandonment Program
Corrective Action Implementation Work Plan Building 207/231 Area

| Well Name | Water Bearing Zone | Location With Respect to Remedial Units | Perform Well Abandonment During Construction | PRE-CONSTRUCTION MONITORING PROGRAM [3]<br><br>Frequency and Duration: One-time sampling event at least 2 months prior to start of construction<br><br>Analytes: TPHd/fo (EPA Method 8015); VOCs (EPA Method 8260); As, Al, Mn, Fe (EPA Method 6010)<br><br>Field Analysis: Water levels, pH, specific conductance, dissolved oxygen (DO) | POST-CONSTRUCTION MONITORING PROGRAM [1] [4]<br><br>Frequency:<br>Excavation Alternative (RUs 207, 38, 231, 230)<br>YEAR 1: Quarterly<br>AFTER YEAR 1: As, Al, Mn, Fe Annually and all other analytes and Field Analysis Semi-Annually<br><br>Capping Alternative (RU 228)<br>YEAR 1: Quarterly<br>YEAR 2: As, Al, Mn, Fe Annually and all other analytes and Field Analysis Semi-Annually<br>YEARS 3--10: Annually<br><br>Duration:<br>Monitor As, Al, Mn, Fe until Arsenic concentrations are below cleanup levels.<br>Monitor all other analytes until COCs are below cleanup levels for 4 consecutive monitoring events.<br>Monitoring will cease on a per individual analyte suite (e.g., VOCs) and /or by well basis<br><br>Analytes: See RU-specific list of analytes below<br><br>Field Analysis: Water levels, pH, specific conductance, Dissolved oxygen (well-specific) |
|---|---|---|---|---|---|
| 231GW26 | INTERMEDIATE | downgradient of RU 231 | X | X | |
| 231GW27 | INTERMEDIATE | west/cross-gradient of RUs | X | | |
| 231GW28 | INTERMEDIATE | east/upgradient of RU 231 | X | | |
| 231GW29 | INTERMEDIATE | west/cross-gradient to RU 230 | X | | |
| 231GW30 | SHALLOW | upgradient of RU 207 | X | | |
| 231PZ01 | SHALLOW | downgradient of RU 231 | X | X | |
| 231PZ02 | SHALLOW | downgradient of RU 231 | X | | |
| 231PZ03 | SHALLOW | west/cross-gradient to RU 230 | X | | |
| 231PZ04 | SHALLOW | west/cross-gradient to RU 230 | X | X | |
| OW-1 | INTERMEDIATE | west/cross-gradient to RU 230 | X | | |
| HGB-2-20 | -- | west/cross-gradient to RU 38 | X | | |
| HGB-2-40 | -- | west/cross-gradient to RU 38 | X | | |
| HGB-2-71 | -- | west/cross-gradient to RU 38 | X | | |
| HGB-3-28 | -- | west/cross-gradient to RU 230 | X | | |
| HGB-3-64 | -- | west/cross-gradient to RU 230 | X | | |
| HGB-3-74 | -- | west/cross-gradient to RU 230 | X | | |
| 231EW01 | -- | downgradient of RU 231 | X | | |
| 231EW02 | -- | downgradient of RU 231 | X | | |
| 231EW03 | -- | downgradient of RU 231 | X | | |
| 231EW04 | -- | downgradient of RU 231 | X | | |
| 231EW05 | -- | downgradient of RU 231 | X | | |
| 231EW06 | -- | downgradient of RU 231 | X | | |
| 231EW07 | -- | downgradient of RU 231 | X | | |
| 231IW01 | -- | downgradient of RU 231 | X | | |
| 231IW02 | -- | downgradient of RU 231 | X | | |
| 231IW03 | -- | downgradient of RU 231 | X | | |
| 231IW04 | -- | downgradient of RU 231 | X | | |
| 231IW05 | -- | downgradient of RU 231 | X | | |
| 231IW06 | -- | downgradient of RU 231 | X | | |
| 231IW07 | -- | downgradient of RU 231 | X | | |
| 231IW08 | -- | downgradient of RU 231 | X | | |
| 231IW09 | -- | downgradient of RU 231 | X | | |
| 231IW10 | -- | downgradient of RU 231 | X | | |
| 231IW11 | -- | downgradient of RU 231 | X | | |
| BUILDING 228 AREA REMEDIAL UNIT | | | | | |
| New Well 1A (231GW200A) | SHALLOW | downgradient of RU 228 | RETAIN | X[5] | TPHd, TPHfo (EPA Method 8015)<br>VOCs [1,2-DCB] (EPA Method 8260)<br>Nickel (EPA Method 6010) |
| New Well 1B (231GW200B) | INTERMEDIATE | downgradient of RU 228 | RETAIN | X[5] | TPHd, TPHfo (EPA Method 8015)<br>VOCs [1,2-DCB] (EPA Method 8260)<br>Nickel (EPA Method 6010) |
| BUILDING 38 AREA REMEDIAL UNIT | | | | | |
| New Well 5 | SHALLOW | downgradient of RU 38 | RETAIN | | TPHd,fo (EPA Method 8015 w/SGCU)<br>PAHs (EPA Method 8270-SIM)<br>Lead, Zinc (EPA Method 6010) |
| BUILDING 230 AREA REMEDIAL UNIT [2] | | | | | |
| 231GW11 | SHALLOW | downgradient of RU 230 | RETAIN | X | Soil COCs for which groundwater will be monitored:<br>TPHd,fo (EPA Method 8015 w/SGCU)<br>PAHs (EPA Method 8270-SIM)<br>Lead, Zinc, As (EPA Method 6010)<br>Redox Parameters |

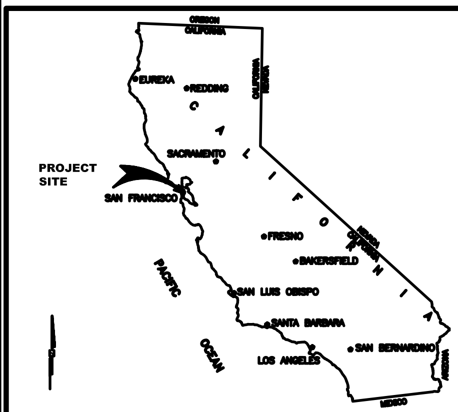
FOOTNOTES:
START OF CONSTRUCTION WILL BE CONTINGENT UPON REGULATORY (Water Board) APPROVAL OF THE BUILDING 207/231 CAP AREA IMPLEMENTATION WORK PLAN.
-- = INDICATES DATA IS NOT APPLICABLE OR AVAILABLE.
[1] ALL POST-CONSTRUCTION MONITORING WELLS WILL BE ABANDONED AFTER MONITORING PROGRAM CRITERIA ARE MET UPON REGULATORY APPROVAL.
[2] NO GROUNDWATER SAMPLING WAS CONDUCTED AT BUILDING 230 RU, THEREFORE, COCs IN GROUNDWATER NOT IDENTFIED; ANALYZE FOR SOIL COCs.
[3] PRE-CONSTRUCTION MONITORING OBJECTIVES: ONE TIME MONITORING EVENT TO FURTHER ESTABLISH PRE-CONSTRUCTION BASELINE CONDITIONS FOR (1) PETROLEUM-RELATED COC CONCENTRATION TRENDS, AND (2) ARSENIC AND ASSOCIATED REDOX PARAMETERS. PERFORMED FIRST QUARTER 2008.
[4] POST-CONSTRUCTION MONITORING OBJECTIVES: CONDUCT POST-CONSTRUCTION ASSESSMENT OF (1) REMEDY EFFECTIVENESS IN REDUCING COC CONCENTRATIONS BELOW CLEANUP LEVELS, AND (2) POTENTIAL FOR OBTAINING CLEAN CLOSURE OF RU / LISTING OF LAND USE CONTROL IF / WHEN CLEANUP LEVELS ARE MET IN GROUNDWATER AS FOLLOWS.
YEAR 1: MONITOR FOR (1) ARSENIC AND ASSOCIATED REDOX PARAMETERS, AND (2) RU-SPECIFIC COCs.
AFTER YEAR 1: MONITOR FOR (1) ARSENIC AND ASSOCIATED REDOX PARAMETERS ANNUALLY (2) RU-SPECIFIC COCs SEMI-ANNUALLY.
"REDOX PARAMETERS" ARE OTHER METALS ANALYZED UNDER EPA TEST METHOD 6010 WITH As (Al, Fe, Mn) AND FIELD MEASUREMENT OF DISSOLVED OXYGEN (DO) AND OXIDATION REDUCTION POTENTIAL (ORP).
[5] WELLS INSTALLED JANUARY/FEBRUARY, 2008 (T&R, 2008). MONITORING PERFORMED FIRST AND SECOND QUARTERS, 2008.

Checked: MS Approved: RR

FIGURES




NOT TO SCALE




LOCATION MAP
NOT TO SCALE

## LEGEND

BUILDING 207/231 PROJECT AREA

## NOTES

1. SITE TOPOGRAPHY PROVIDED BY PRESIDIO TRUST AS PERFORMED BY KUCERA INTERNATIONAL INC, 38133 WESTERN PARKWAY, WILLOUGHBY, OH 44094, (440)975-4230. DATE OF TOPOGRAPHIC AERIAL SURVEY IS MARCH 24, 2000. DATE OF GPS GROUND CONTROL IS APRIL 20, 2000. THE COORDINATES ARE BASED ON NAD 27 CALIFORNIA STATE PLANE - ZONE 3 - U.S. SURVEY FEET. ELEVATIONS ARE BASED ON NAVD 88 - U.S. SURVEY FEET. UPDATED TOPOGRAPHIC MAPPING PROVIDED BY CHAUDHARY & ASSOC. USING THE SAME DATUMS, UNDER SUBCONTRACT TO MACTEC ON APRIL 7, 2005.

2. SEE CONTRACT SPECIFICATIONS FOR ADDITIONAL INFORMATION REGARDING SITE CONDITIONS AND REQUIREMENTS OF WORK.

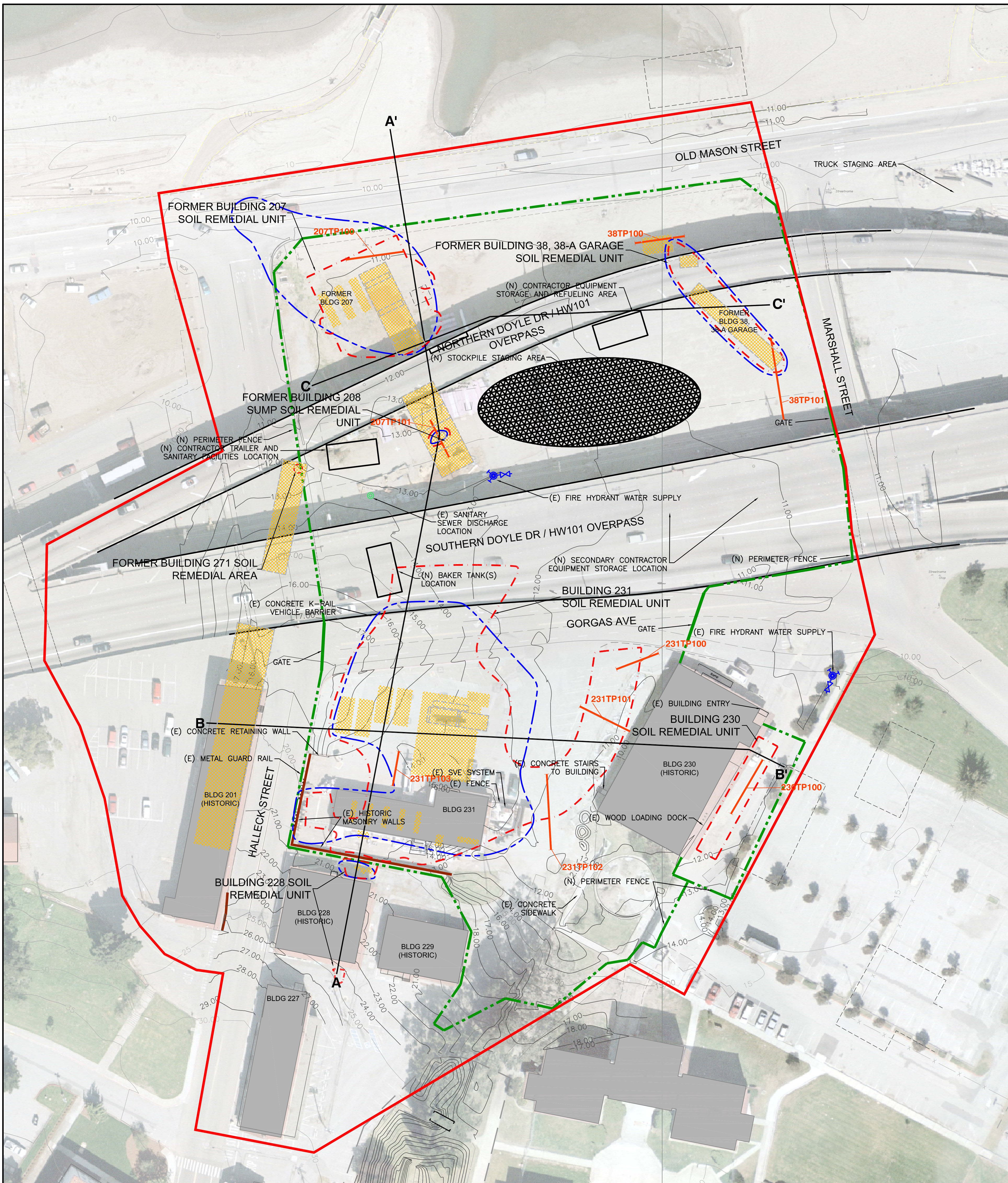
4084075106018.DWG 1.0
20081016.0839

MACTEC

SITE LOCATION MAP
PRESIDIO BUILDING 207/231 AREA
PRESIDIO SAN FRANCISCO
SAN FRANCISCO, CALIFORNIA

FIGURE
1-1

| DRAWN | FILE NAME | PROJECT NUMBER | CHECKED | DATE | APPROVED | DATE |
|---|---|---|---|---|---|---|
| JHD | 4084075106018savex | 4084075106 | JHD | 10/2008 | RR | 10/2008 |




## LEGEND

| | |
|---|---|
| HISTORIC WALL | PERIMETER FENCE |
| TOPOGRAPHIC CONTOUR | STOCKPILE STAGING AREA |
| BUILDING 207/231 AREA | FORMER STRUCTURE OR FEATURE |
| GROUNDWATER REMEDIAL UNITS | SANITARY SEWER MANHOLE (SEE CONSTRUCTION DRAWINGS C-101 AND 102 FOR ASSOCIATED UTILITY PIPEING) |
| SOIL REMEDIAL UNITS | FIRE HYDRANT (SEE CONSTRUCTION DRAWINGS C-101 AND 102 FOR ASSOCIATED UTILITY PIPEING) |
| GEOARCHAEOLOGICAL TRENCH LOCATION | |
| GEOLOGIC CROSS SECTION B—B' | |

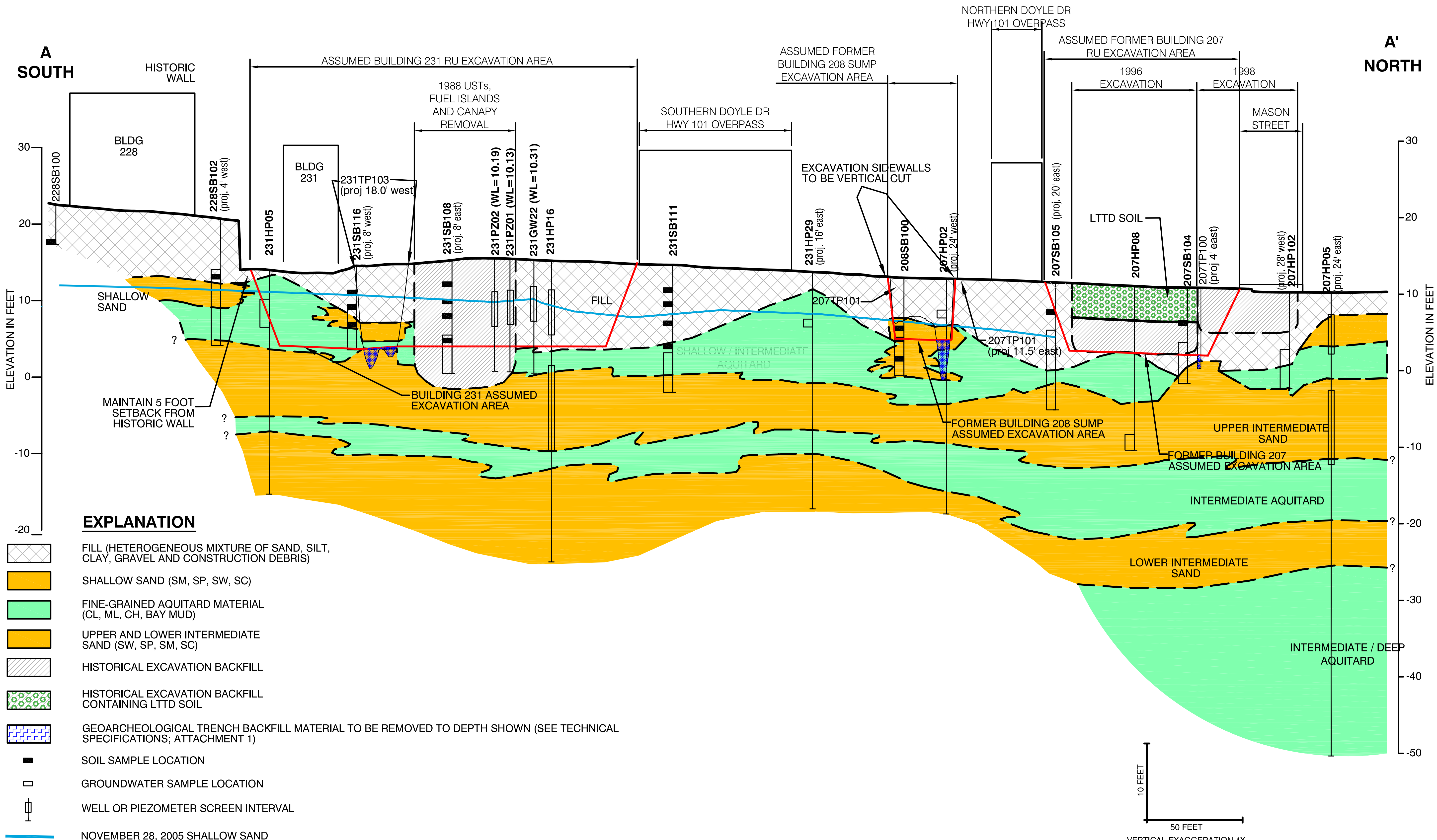
4084075106019.DWG 96.0
20081016.0845

MACTEC

SITE PLAN AND REMEDIAL UNITS
PRESIDIO BUILDING 207/231 AREA
PRESIDIO SAN FRANCISCO
SAN FRANCISCO, CALIFORNIA

FIGURE:
1-2

| DRAWN | JOB NUMBER | CHECKED | CHECKED DATE | APPROVED | APPROVED DATE |
|---|---|---|---|---|---|
| JHD | 4084075106 | JHD | 10/2008 | RR | 10/2008 |




## EXPLANATION

- FILL (HETEROGENEOUS MIXTURE OF SAND, SILT, CLAY, GRAVEL AND CONSTRUCTION DEBRIS)
- SHALLOW SAND (SM, SP, SW, SC)
- FINE-GRAINED AQUITARD MATERIAL (CL, ML, CH, BAY MUD)
- UPPER AND LOWER INTERMEDIATE SAND (SW, SP, SM, SC)
- HISTORICAL EXCAVATION BACKFILL
- HISTORICAL EXCAVATION BACKFILL CONTAINING LTTD SOIL
- GEOARCHEOLOGICAL TRENCH BACKFILL MATERIAL TO BE REMOVED TO DEPTH SHOWN (SEE TECHNICAL SPECIFICATIONS; ATTACHMENT 1)
- SOIL SAMPLE LOCATION
- GROUNDWATER SAMPLE LOCATION
- WELL OR PIEZOMETER SCREEN INTERVAL
- NOVEMBER 28, 2005 SHALLOW SAND POTENTIOMETRIC SURFACE (TREADWELL AND ROLLO, OCTOBER 2006)
- PROFILE OF ASSUMED EXCAVATION AREA

NOTES:

1. CROSS-SECTION LOCATIONS ARE SHOWN ON FIGURE 1-2.
2. HORIZONTAL DATUM: NAD 27 CALIFORNIA STATE PLANE - ZONE 3
   VERTICAL DATUM: NAVD 88 - U.S. SURVEY FEET.
3. POTENTIOMETRIC SURFACE WAS GENERATED FROM DATA SHOWN IN THE SEMI ANNUAL GROUNDWATER MONITORING REPORT 1ST AND 2ND QUARTERS 2006(TREADWELL AND ROLLO, OCTOBER 2006). THE DATA WAS CONVERTED FROM PLLW TO BE CONSISTENT WITH TOPOGRAPHIC SURVEY DATA. CONVERSION: NAVD 88 = PLLW-0.37
4. BECAUSE GROUNDWATER ELEVATIONS VARY BASED ON SEASONAL CONDITIONS, USING GROUNDWATER ELEVATIONS IN HYDROPUNCH BORINGS MAY NOT ACCURATELY REFLECT THE TRUE HIGH HIGH GROUNDWATER ELEVATION AND THEREFORE, DATA FROM THESE POINTS ARE NOT USED TO DEVELOP THE POTENTIOMETRIC SURFACE.

MACTEC

GEOLOGIC CROSS-SECTION A-A'
PRESIDIO BUILDING 207/231 AREA
PRESIDIO OF SAN FRANCISCO
SAN FRANCISCO, CALIFORNIA

FIGURE 1-3

| DRAWN | JOB NUMBER | CHECKED | CHECKED DATE | APPROVED | APPROVED DATE |
|---|---|---|---|---|---|
| JHD | 4084075106 07 | JHD | 10/2008 | RR | 10/2008 |

40.0
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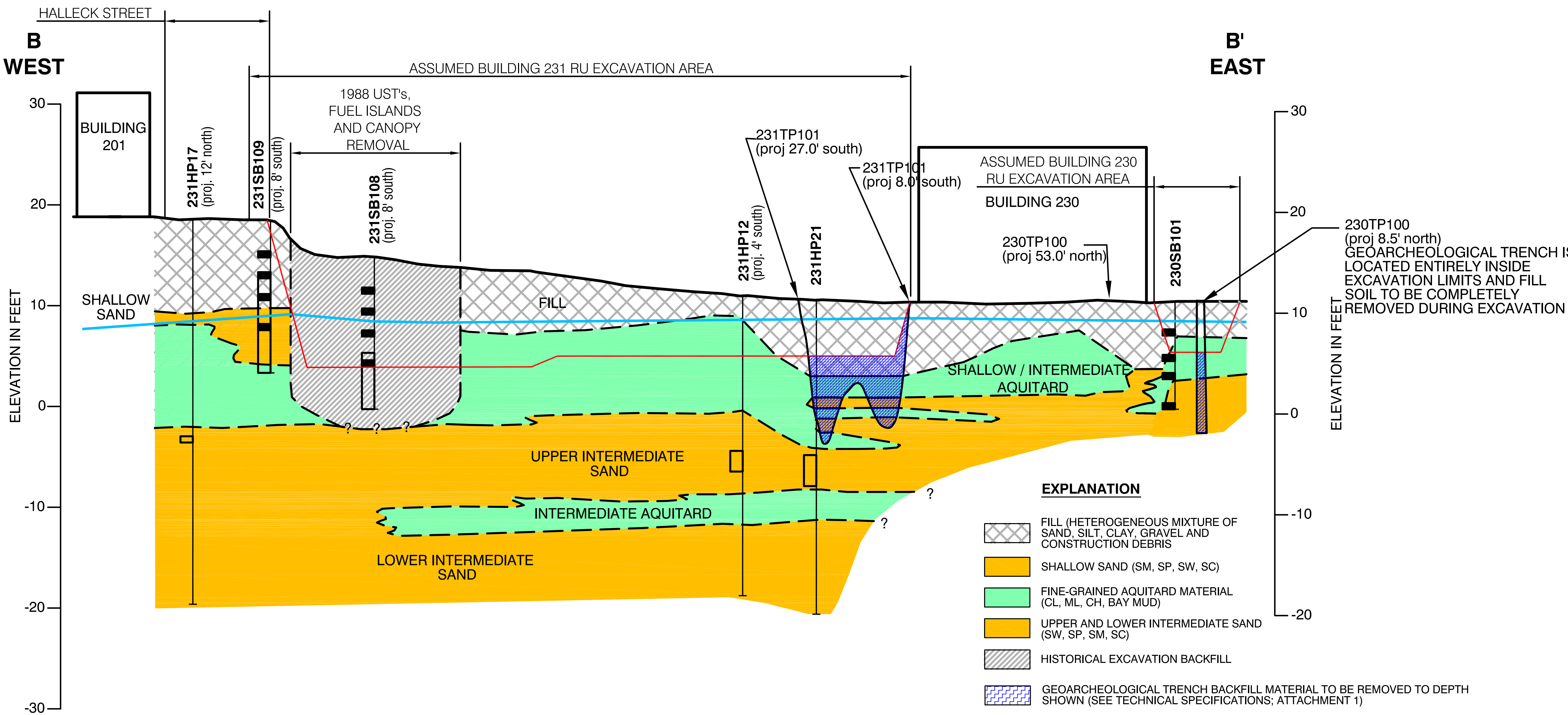
20081015.1627




**EXPLANATION**

- FILL (HETEROGENEOUS MIXTURE OF SAND, SILT, CLAY, GRAVEL AND CONSTRUCTION DEBRIS
- SHALLOW SAND (SM, SP, SW, SC)
- FINE-GRAINED AQUITARD MATERIAL (CL, ML, CH, BAY MUD)
- UPPER AND LOWER INTERMEDIATE SAND (SW, SP, SM, SC)
- HISTORICAL EXCAVATION BACKFILL
- GEOARCHEOLOGICAL TRENCH BACKFILL MATERIAL TO BE REMOVED TO DEPTH SHOWN (SEE TECHNICAL SPECIFICATIONS; ATTACHMENT 1)
- SOIL SAMPLE LOCATION
- GROUNDWATER SAMPLE LOCATION
- WELL OR PIEZOMETER SCREEN INTERVAL
- NOVEMBER 28, 2005 SHALLOW SAND POTENTIOMETRIC SURFACE (TREADWELL AND ROLLO, OCTOBER 2006)
- PROFILE OF ASSUMED EXCAVATION AREA

10 FEET

40 FEET

VERTICAL EXAGGERATION 4X

NOTES:

1. CROSS-SECTION LOCATIONS ARE SHOWN ON FIGURE 1-2.
2. HORIZONTAL DATUM: NAD 27 CALIFORNIA STATE PLANE - ZONE 3
   VERTICAL DATUM: NAVD 88 - U.S. SURVEY FEET.
3. POTENTIOMETRIC SURFACE WAS GENERATED FROM DATA SHOWN IN THE SEMI ANNUAL GROUNDWATER MONITORING REPORT 1ST AND 2ND QUARTERS 2006(TREADWELL AND ROLLO, OCTOBER 2006). THE DATA WAS CONVERTED FROM PLLW TO BE CONSISTENT WITH TOPOGRAPHIC SURVEY DATA. CONVERSION: NAVD 88 = PLLW-0.37
4. BECAUSE GROUNDWATER ELEVATIONS VARY BASED ON SEASONAL CONDITIONS, USING GROUNDWATER ELEVATIONS IN HYDROPUNCH BORINGS MAY NOT ACCURATELY REFLECT THE TRUE HIGH HIGH GROUNDWATER ELEVATION AND THEREFORE, DATA FROM THESE POINTS ARE NOT USED TO DEVELOP THE POTENTIOMETRIC SURFACE.

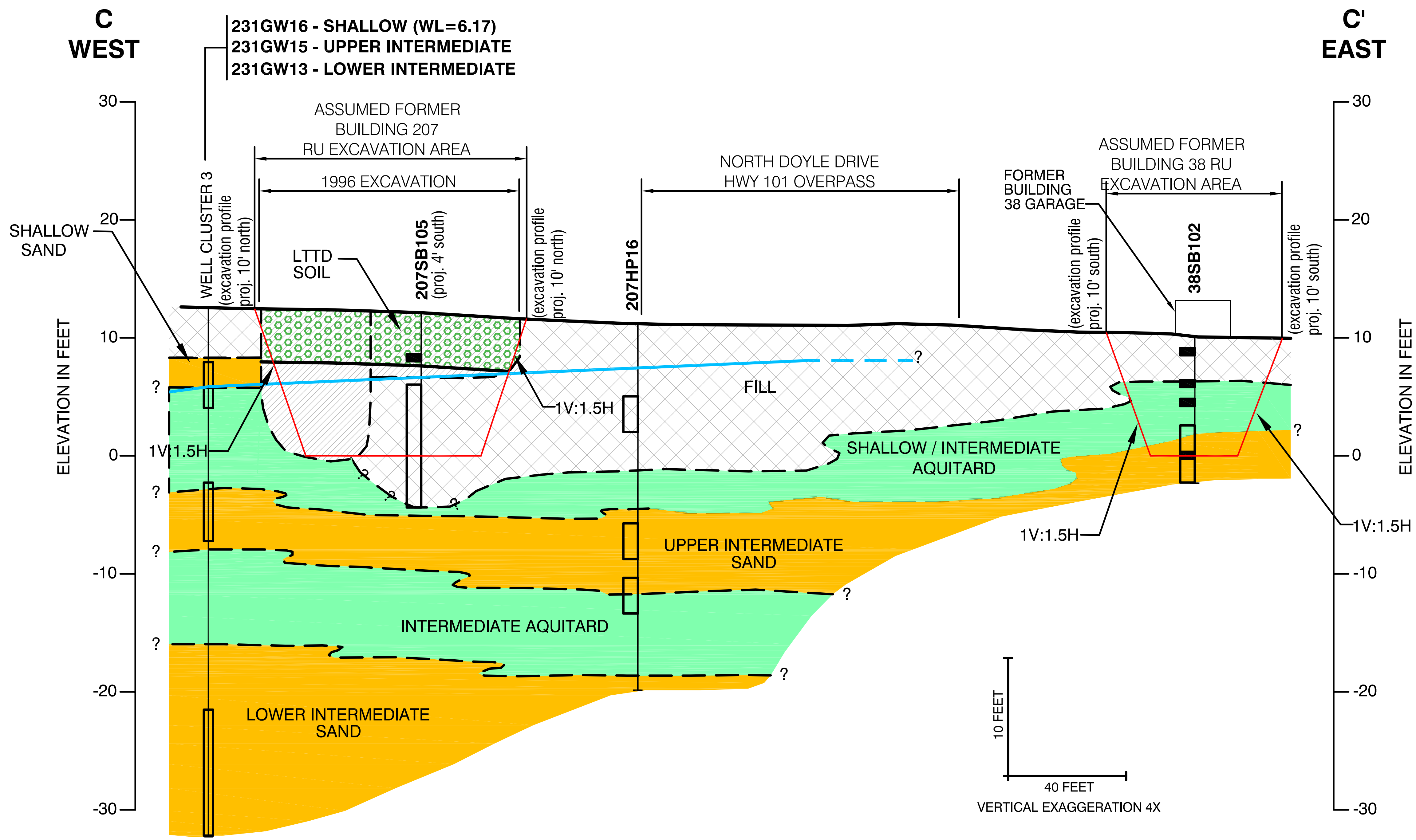
40840751060021.DWG 40.0
20081015.1514

MACTEC

GEOLOGIC CROSS-SECTION B-B'
PRESIDIO BUILDING 207/231 AREA
PRESIDIO OF SAN FRANCISCO
SAN FRANCISCO, CALIFORNIA

FIGURE
**1-4**

| DRAWN | JOB NUMBER | CHECKED | CHECKED DATE | APPROVED | APPROVED DATE |
|---|---|---|---|---|---|
| JHD | 4084075106 | JHD | 10/2008 | RR | 10/2008 |




**EXPLANATION**

- FILL (HETEROGENEOUS MIXTURE OF SAND, SILT, CLAY, GRAVEL AND CONSTRUCTION DEBRIS
- SHALLOW SAND (SM, SP, SW, SC)
- FINE-GRAINED AQUITARD MATERIAL (CL, ML, CH, BAY MUD)
- UPPER AND LOWER INTERMEDIATE SAND (SW, SP, SM, SC)
- HISTORICAL EXCAVATION BACKFILL
- HISTORICAL EXCAVATION BACKFILL CONTAINING LTTD SOIL
- GEOARCHEOLOGICAL TRENCH BACKFILL MATERIAL TO BE REMOVED TO DEPTH SHOWN(SEE TECHNICAL SPECIFICATIONS; ATTACHMENT 1)
- SOIL SAMPLE LOCATION
- GROUNDWATER SAMPLE LOCATION
- WELL OR PIEZOMETER SCREEN INTERVAL
- NOVEMBER 28, 2005 SHALLOW SAND POTENTIOMETRIC SURFACE (TREADWELL AND ROLLO, OCTOBER 2006)
- PROFILE OF ASSUMED EXCAVATION AREA

NOTES:

1. CROSS-SECTION LOCATIONS ARE SHOWN ON FIGURE 1-2.
2. HORIZONTAL DATUM: NAD 27 CALIFORNIA STATE PLANE - ZONE 3
   VERTICAL DATUM: NAVD 88 - U.S. SURVEY FEET.
3. POTENTIOMETRIC SURFACE WAS GENERATED FROM DATA SHOWN IN THE SEMI ANNUAL GROUNDWATER MONITORING REPORT 1ST AND 2ND QUARTERS 2006(TREADWELL AND ROLLO, OCTOBER 2006). THE DATA WAS CONVERTED FROM PLLW TO BE CONSISTENT WITH TOPOGRAPHIC SURVEY DATA. CONVERSION: NAVD 88 = PLLW-0.37
4. BECAUSE GROUNDWATER ELEVATIONS VARY BASED ON SEASONAL CONDITIONS, USING GROUNDWATER ELEVATIONS IN HYDROPUNCH BORINGS MAY NOT ACCURATELY REFLECT THE TRUE HIGH HIGH GROUNDWATER ELEVATION AND THEREFORE, DATA FROM THESE POINTS ARE NOT USED TO DEVELOP THE POTENTIOMETRIC SURFACE.

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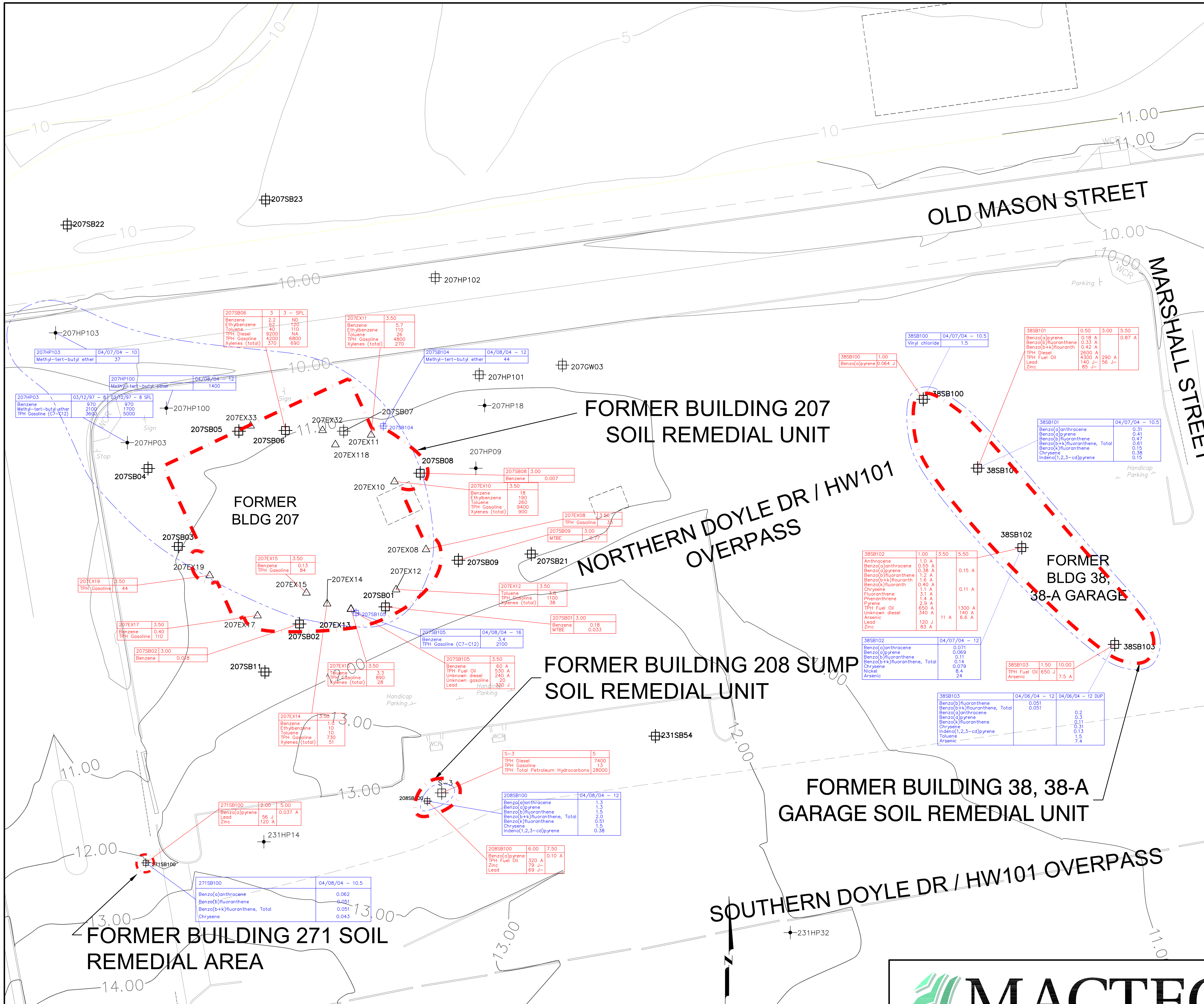
20081015.1516

MACTEC

GEOLOGIC CROSS-SECTION C-C'
PRESIDIO BUILDING 207/231 AREA
PRESIDIO OF SAN FRANCISCO
SAN FRANCISCO, CALIFORNIA

FIGURE
1-5

| DRAWN | JOB NUMBER | CHECKED | CHECKED DATE | APPROVED | APPROVED DATE |
|---|---|---|---|---|---|
| JHD | 4084075106 | JHD | 10/2008 | RR | 10/2008 |




| Chemical | Final Soil Cleanup Levels (mg/kg) | Groundwater Cleanup Levels (µg/L) |
|---|---|---|
| **Total Petroleum Hydrocarbons (TPH)** | | |
| TPH as gasoline | 11.6 | 443 |
| TPH as diesel | 115 | 443 |
| TPH as fuel oil | 144 | 443 |
| TPH Unknown Diesel Hydrocarbon | -- | 443 |
| TPH Unknown Gasoline Hydrocarbon | -- | 443 |
| **Polynuclear Aromatic Compounds (PAHs)** | | |
| Acenaphthene | 0.31 | 1200 |
| Acenaphthylene | 0.067 | -- |
| Anthracene | 0.45 | 770 |
| Benzo(a)anthracene | 0.27 | 0.0044 |
| Benzo(a)pyrene (B[a]P) | 0.027 | 0.0044 |
| Benzo(b)fluoranthene | 0.27 | 0.0044 |
| Benzo(b+k)flouranthene, Total | 0.27 | 0.0044 |
| Benzo(g,h,i)perylene | 0.25 | 150 |
| Benzo(k)fluoranthene | 0.27 | 0.0044 |
| Chrysene | 0.67 | 0.0044 |
| Dibenzo(a,h)anthracene | 0.071 | -- |
| Fluoranthene | 1.5 | 300 |
| Fluorene | 0.28 | 300 |
| Indeno(1,2,3-cd)pyrene | 0.26 | 0.0044 |
| Naphthalene | 0.3 | 300 |
| Phenanthrene | 0.61 | 230 |
| Pyrene | 0.79 | 230 |
| Total PAHs | 5.6 | 0.031 |
| **Metals / Inorganics** | | |
| Aluminum | 76000 | 1,000 |
| Arsenic | 6.2 | 10 |
| Barium | 320 | 1,000 |
| Beryllium | 10 | -- |
| Cadmium | 0.8 | 1.1 |
| Calcium | -- | -- |
| Chloride | -- | 250,000 |
| Chromium | 140 | 50 |
| Cobalt | 21 | 3 |
| Copper | 49 | 3.1 |
| Cyanide | 1000 | -- |
| Iron | 23000 | -- |
| Lead | 50 | 2.5 |
| Magnesium | -- | -- |
| Manganese | 1800 | -- |
| Mercury | 0.4 | -- |
| Nickel | 110 | 8.2 |
| Nitrate | -- | 10,000 |
| Potassium | -- | -- |
| Silver | 1 | -- |
| Sodium | -- | -- |
| Vanadium | 90 | 15 |
| Zinc | 60 | 81 |
| **Volatile Organic Compounds (VOCs)** | | |
| 1,1,1-Trichloroethane | -- | 200 |
| 1,1,2,2-Tetrachloroethane | -- | 1 |
| 1,1,2-Trichloroethane | -- | 5 |
| 1,1,-Dichloroethane | -- | 5 |
| 1,2,4-Trimethylbenzene | 52 | -- |
| 1,2-Dichlorobenzene | 1.1 | 14 |
| 1,2-Dichloroethane | -- | 0.38 |
| 1,2-Dichloroethene (cis & trans) | -- | 6 |
| 1,2-Dichloropropane | -- | 5 |
| 1,3,5-Trimethylbenzene | 21 | -- |
| 1,3-Dichlorobenzene | -- | 65 |
| 1,4-Dichlorobenzene | 0.13 | 5 |
| 2-Butanone | 3.8 | 4,200 |
| 2-Hexanone | 2.8 | 700 |
| Acetone | 0.24 | 1,500 |
| Benzene | 0.005 | 1 |
| Bromoform | -- | 100 |
| Carbon dioxide | -- | -- |
| Carbon disulfide | 200 | -- |
| Chlorobenzene | -- | 70 |
| Chloroform | -- | 80 |
| Chloromethane | -- | 1.3 |
| cis-1,2-Dichloroethene | 0.19 | 6 |
| Ethane | -- | -- |
| Ethene | -- | -- |
| Ethylbenzene | 5 | 43 |
| Methane | -- | -- |
| Methyl t-butyl ether | 0.023 | 13 |
| Methylene chloride | 0.076 | 4.7 |
| sec-Butylbenzene | -- | -- |
| Styrene | -- | 100 |
| tert-Butylbenzene | -- | -- |
| Tetrachloroethene | 0.087 | 0.8 |
| Toluene | 1 | 150 |
| Trichloroethene | 0.26 | 2.7 |
| Trichlorofluoromethane | -- | 150 |
| Vinyl chloride | -- | 0.5 |
| Xylenes | 5.7 | 130 |
| Xylenes (m&p-) | 5.7 | 130 |
| Xylenes (o-) | 5.7 | 130 |
| **Semi-Volatile Organic Compounds (SVOCs)** | | |
| Bis(2-ethylhexyl)phthalate | 66 | -- |
| **Pesticides and PCBs** | | |
| 4,4-DDD | 0.011 | -- |
| Arochlor 1016 | 0.033 | 0.00017 |
| **Polychlorinated Biphenyls (PCBs)** | | |
| PCB 1016 | -- | 0.00017 |

HYDROPUNCH
SOIL BORING LOCATION
EXCAVATION SAMPLE LOCATION
SOIL BORING LOCATION WITH GRAB GROUNDWATER SAMPLE
GROUNDWATER REMEDIAL UNITS
SOIL REMEDIAL UNITS

GROUNDWATER CONCENTRATIONS EXCEEDING CLEANUP LEVELS:

| 38SB100 | 04/07/04 – 10.5 |
|---|---|
| Vinyl chloride | 1.5 |

STATION NAME
DATE AND DEPTH OF SAMPLE
CONCENTRATION µg/L
ANALYTE

SOIL CONCENTRATIONS EXCEEDING CLEANUP LEVELS:

| 38SB100 | 1.00 |
|---|---|
| Benzo(a)pyrene | 0.64 J |

STATION NAME
DEPTH OF SAMPLE
CONCENTRATION mg/kg
ANALYTE

- SPL = Split - DUP = DUPLICATE

NOTE:
1. ONLY RESULTS THAT WERE DETECTED ABOVE CLEANUP LEVELS ARE SHOWN.
2. DETECTION LIMITS FOR VARIOUS PESTICIDES EXCEEDED CLEANUP LEVELS.
3. MOST CONSERVATIVE CLEANUP LEVELS ARE USED IN THE POSTING ON THIS FIGURE.

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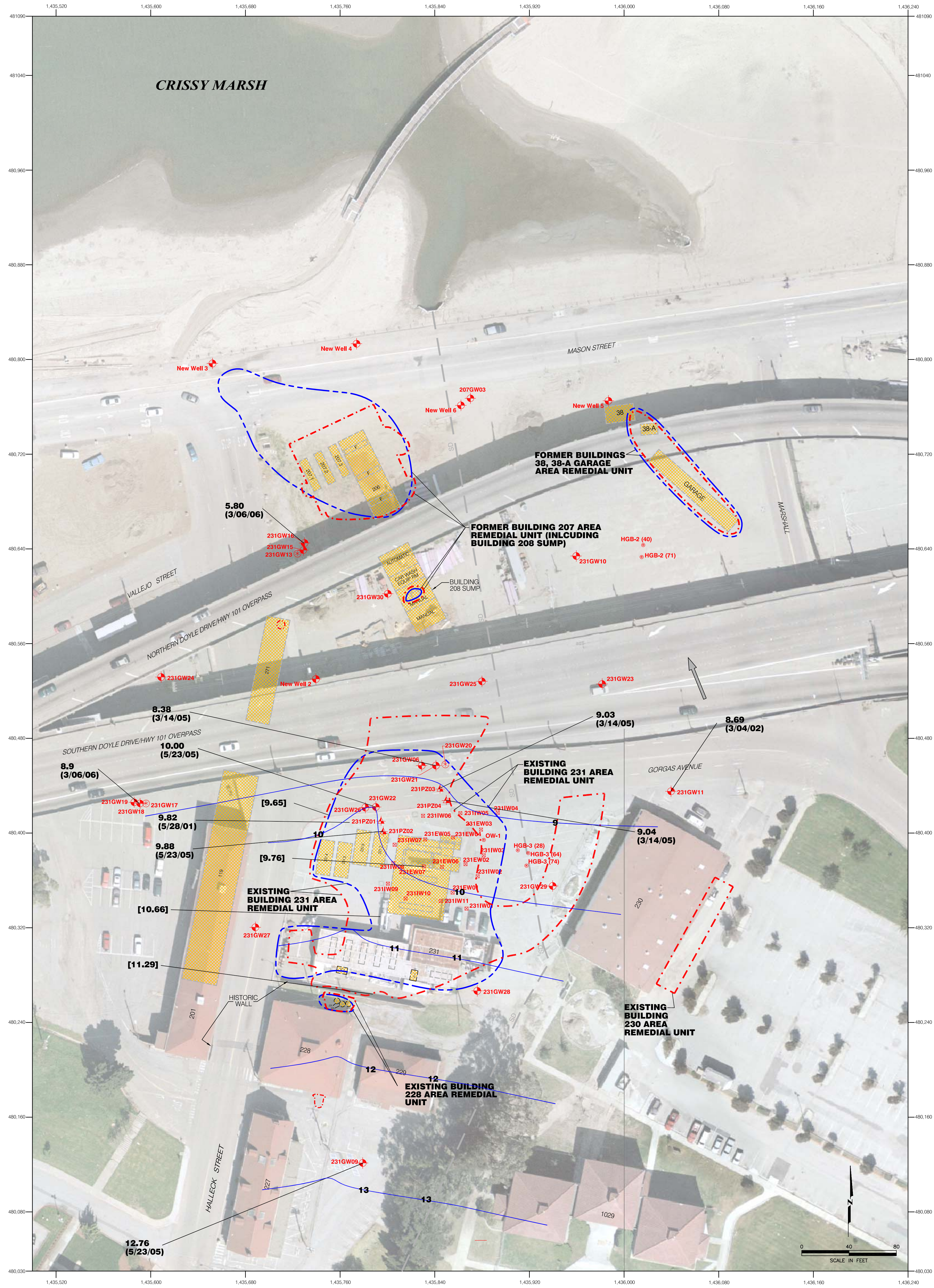
MACTEC

SOIL AND GROUNDWATER CONCENTRATIONS
EXCEEDING CLEANUP LEVELS - BUILDING 207 AREA
PRESIDIO BUILDING 207/231 AREA
PRESIDIO SAN FRANCISCO
SAN FRANCISCO, CALIFORNIA

FIGURE
1-6

| DRAWN | JOB NUMBER | CHECKED | CHCK'D DATE | APPROVED | APPRV'D DATE |
|---|---|---|---|---|---|
| JHD | 4084075106 02 | JHD | 10/2008 | RR | 10/2008 |




## REFERENCES

1. HIGHEST REPORTED GROUNDWATER ELEVATION DATA FROM 2001 THROUGH 2006 FOUND IN THE PRESIDIO SEMI ANNUAL GROUNDWATER MONITORING REPORT 1ST AND 2ND QUARTERS 2006 (TREADWELL AND ROLLO, OCTOBER 2006)

2. ALL WATER LEVELS ARE SHOWN IN NAVD 88- US SURVEY FEET, THEY HAVE BEEN CONVERTED FROM PLLW TO BE CONSISTENT WITH TOPOGRAPHIC SURVEY DATA.
CONVERSION: NAVD 88 = PLLW-0.37

NOTE:
AERIAL PHOTOGRAPHY DATA MARCH 24, 2000 SOURCE: PRESIDIO TRUST GIS DEPARTMENT.

## EXPLANATION

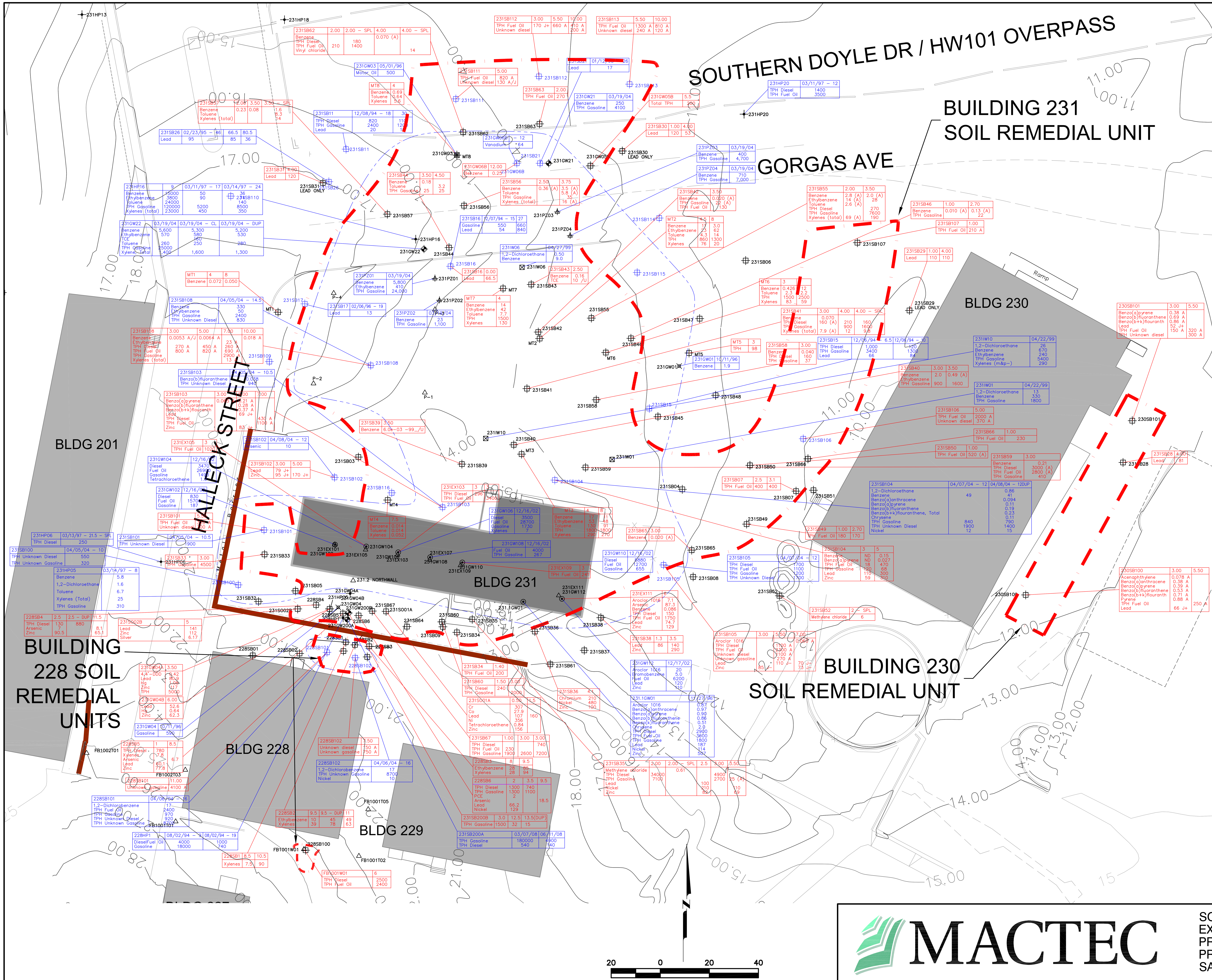
- SVE AND GROUNDWATER INJECTION (IW) OR EXTRACTION (EW) WELL
- GROUNDWATER REMEDIAL UNITS
- SOIL REMEDIAL UNITS
- MONITORING WELL - SHALLOW SAND
- MONITORING WELL - DEEP SAND
- PIEZOMETER - SHALLOW SAND
- 9 HIGH GROUNDWATER CONTOUR
- SD TENNESSEE HOLLOW UNDERGROUND PIPELINE
- APPROXIMATE DIRECTION OF SHALLOW ZONE GROUNDWATER FLOW (MAY 24, 2004)
- [11.67] INTERPOLATED SHALLOW ZONE GROUNDWATER ELEV. (NAVD 88) USED FOR CONTOUR GENERATION ONLY.
- 10.25 (5/23/05) HISTORICAL HIGH SHALLOW ZONE GROUNDWATER ELEV. (NAVD 88) & DATE MONITORED (1)
- FORMER STRUCTURE OR FEATURE

MACTEC

HISTORICAL HIGH WATER ELEVATIONS
PRESIDIO BUILDING 207/231 AREA
PRESIDIO OF SAN FRANCISCO
SAN FRANCISCO, CALIFORNIA

FIGURE 2-1

| DRAWN | JOB NUMBER | CHECKED | DATE | APPROVED | DATE |
|---|---|---|---|---|---|
| JHD | 4084075106 | JHD | 10/2008 | RR | 10/2008 |




| Chemical | Final Soil Cleanup Levels (mg/kg) | Groundwater Cleanup Levels (µg/L) |
|---|---|---|
| **Total Petroleum Hydrocarbons (TPH)** | | |
| TPH as gasoline | 11.6 | 443 |
| TPH as diesel | 115 | 443 |
| TPH as fuel oil | 144 | 443 |
| TPH Unknown Diesel Hydrocarbon | -- | 443 |
| TPH Unknown Gasoline Hydrocarbon | -- | 443 |
| **Polynuclear Aromatic Compounds (PAHs)** | | |
| Acenaphthene | 0.31 | 1200 |
| Acenaphthylene | 0.067 | -- |
| Anthracene | 0.45 | 770 |
| Benzo(a)anthracene | 0.27 | 0.0044 |
| Benzo(a)pyrene (B[a]P) | 0.027 | 0.0044 |
| Benzo(b)fluoranthene | 0.27 | 0.0044 |
| Benzo(b+k)flouranthene, Total | 0.27 | 0.0044 |
| Benzo(g,h,i)perylene | 0.25 | 150 |
| Benzo(k)fluoranthene | 0.27 | 0.0044 |
| Chrysene | 0.67 | 0.0044 |
| Dibenzo(a,h)anthracene | 0.071 | -- |
| Fluoranthene | 1.5 | 300 |
| Fluorene | 0.28 | 300 |
| Indeno(1,2,3-cd)pyrene | 0.26 | 0.0044 |
| Naphthalene | 0.3 | 300 |
| Phenanthrene | 0.61 | 230 |
| Pyrene | 0.79 | 230 |
| Total PAHs | 5.6 | 0.031 |
| **Metals / Inorganics** | | |
| Aluminum | 76000 | 1,000 |
| Arsenic | 6.2 | 10 |
| Barium | 320 | 1,000 |
| Beryllium | 10 | -- |
| Cadmium | 0.8 | 1.1 |
| Calcium | -- | -- |
| Chloride | -- | 250,000 |
| Chromium | 140 | 50 |
| Cobalt | 21 | 3 |
| Copper | 49 | 3.1 |
| Cyanide | 1000 | -- |
| Iron | 23000 | -- |
| Lead | 50 | 2.5 |
| Magnesium | -- | -- |
| Manganese | 1800 | -- |
| Mercury | 0.4 | -- |
| Nickel | 110 | 8.2 |
| Nitrate | -- | 10,000 |
| Potassium | -- | -- |
| Silver | 1 | -- |
| Sodium | -- | -- |
| Vanadium | 90 | 15 |
| Zinc | 60 | 81 |
| **Volatile Organic Compounds (VOCs)** | | |
| 1,1,1-Trichloroethane | -- | 200 |
| 1,1,2,2-Tetrachloroethane | -- | 1 |
| 1,1,2-Trichloroethane | -- | 5 |
| 1,1,-Dichloroethane | -- | 5 |
| 1,2,4-Trimethylbenzene | 52 | -- |
| 1,2-Dichlorobenzene | 1.1 | 14 |
| 1,2-Dichloroethane | -- | 0.38 |
| 1,2-Dichloroethene (cis & trans) | -- | 6 |
| 1,2-Dichloropropane | -- | 5 |
| 1,3,5-Trimethylbenzene | 21 | -- |
| 1,3-Dichlorobenzene | -- | 65 |
| 1,4-Dichlorobenzene | 0.13 | 5 |
| 2-Butanone | 3.8 | 4,200 |
| 2-Hexanone | 2.8 | 700 |
| Acetone | 0.24 | 1,500 |
| Benzene | 0.005 | 1 |
| Bromoform | -- | 100 |
| Carbon dioxide | -- | -- |
| Carbon disulfide | 200 | -- |
| Chlorobenzene | -- | 70 |
| Chloroform | -- | 80 |
| Chloromethane | -- | 1.3 |
| cis-1,2-Dichloroethene | 0.19 | 6 |
| Ethane | -- | -- |
| Ethene | -- | -- |
| Ethylbenzene | 5 | 43 |
| Methane | -- | -- |
| Methyl t-butyl ether | 0.023 | 13 |
| Methylene chloride | 0.076 | 4.7 |
| sec-Butylbenzene | -- | -- |
| Styrene | -- | 100 |
| tert-Butylbenzene | -- | -- |
| Tetrachloroethene | 0.087 | 0.8 |
| Toluene | 1 | 150 |
| Trichloroethene | 0.26 | 2.7 |
| Trichlorofluoromethane | -- | 150 |
| Vinyl chloride | -- | 0.5 |
| Xylenes | 5.7 | 130 |
| Xylenes (m&p-) | 5.7 | 130 |
| Xylenes (o-) | 5.7 | 130 |
| **Semi-Volatile Organic Compounds (SVOCs)** | | |
| Bis(2-ethylhexyl)phthalate | 66 | -- |
| **Pesticides and PCBs** | | |
| 4,4-DDD | 0.011 | -- |
| Arochlor 1016 | 0.033 | 0.00017 |
| **Polychlorinated Biphenyls (PCBs)** | | |
| PCB 1016 | -- | 0.00017 |

HYDROPUNCH
SOIL BORING LOCATION
EXCAVATION SAMPLE LOCATION
SOIL BORING LOCATION WITH GRAB GROUNDWATER SAMPLE
GROUND WATER WELL SAMPLE LOCATION
GROUNDWATER REMEDIAL UNITS
SOIL REMEDIAL UNITS

GROUNDWATER CONCENTRATIONS EXCEEDING CLEANUP LEVELS:

| 38SB100 | 04/07/04 – 10.5 |
|---|---|
| Vinyl chloride | 1.5 |

STATION NAME
DATE AND DEPTH OF SAMPLE
CONCENTRATION µg/L
ANALYTE

SOIL CONCENTRATIONS EXCEEDING CLEANUP LEVELS:

| 38SB100 | 1.00 |
|---|---|
| Benzo(a)pyrene | 0.64 J |

STATION NAME
DEPTH OF SAMPLE
CONCENTRATION mg/kg
ANALYTE

- SPL = Split - DUP = DUPLICATE

NOTE:
1. ONLY RESULTS THAT WERE DETECTED ABOVE CLEANUP LEVELS ARE SHOWN.
2. DETECTION LIMITS FOR VARIOUS PESTICIDES EXCEEDED CLEANUP LEVELS.
3. MOST CONSERVATIVE CLEANUP LEVELS ARE USED IN THE POSTING ON THIS FIGURE.

4084075106055.DWG 1.0
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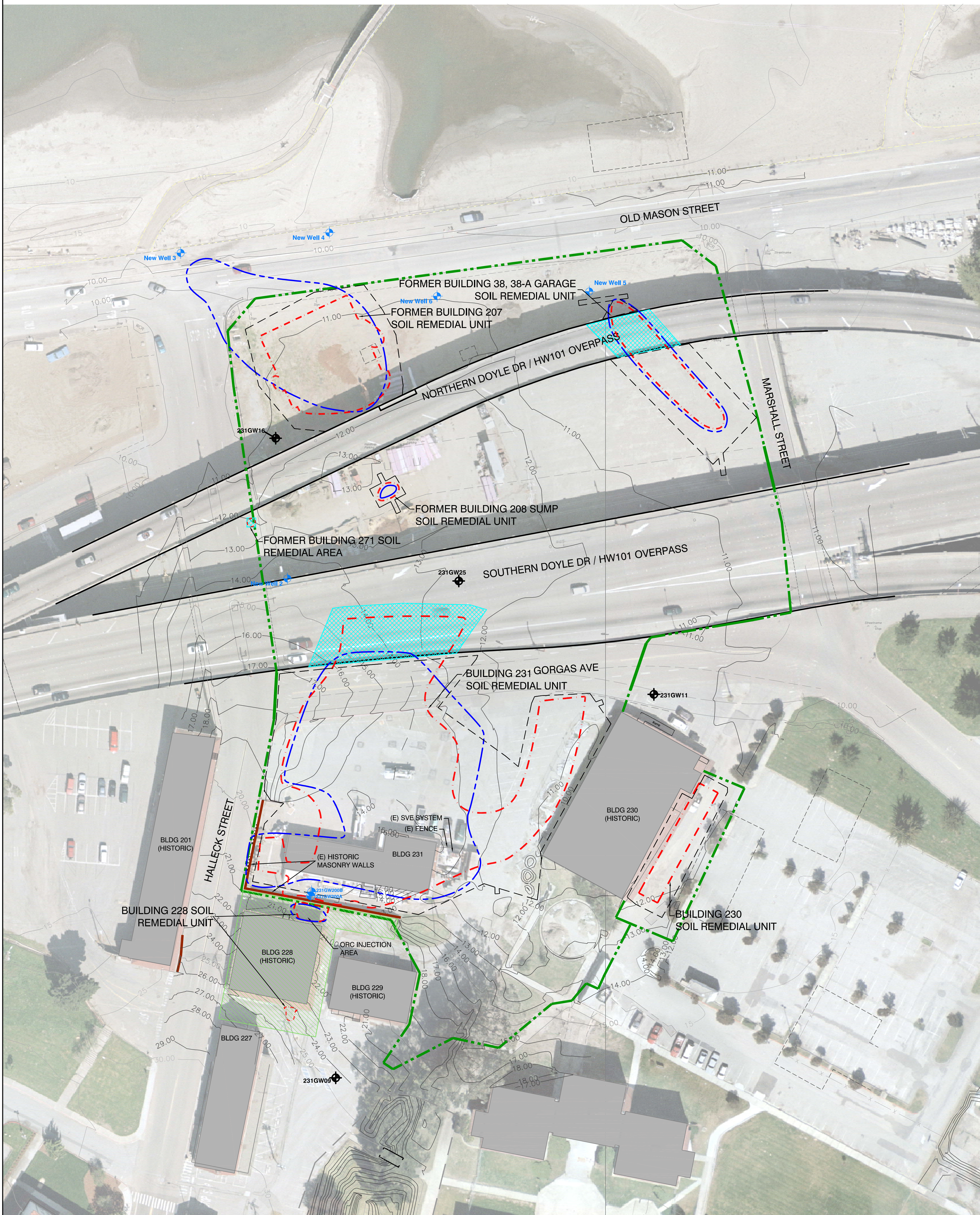
MACTEC

SOIL AND GROUNDWATER CONCENTRATIONS EXCEEDING CLEANUP LEVELS - BUILDING 231 AREA
PRESIDIO BUILDING 207/231 AREA
PRESIDIO SAN FRANCISCO
SAN FRANCISCO, CALIFORNIA

FIGURE 1-7

| DRAWN | JOB NUMBER | CHECKED | CHCK'D DATE | APPROVED | APPRV'D DATE |
|---|---|---|---|---|---|
| JHD | 4084075106 07 | JHD | 10/2008 | RR | 10/2008 |




LEGEND

| | | | |
|---|---|---|---|
| HISTORIC WALL | | TOPOGRAPHIC CONTOUR | 24 |
| PROPOSED MONITORING WELL | New Well 1 | ASSUMED EXCAVATION AREA | |
| LAND USE CONTROL AREA (LUC) | | GROUNDWATER REMEDIAL UNITS | |
| CAPPING/LAND USE CONTROL AREA (LUC) | | SOIL REMEDIAL UNITS | |
| MONITORING WELL TO BE RETAINED | 231GW25 | PERIMETER FENCE | |

N

40 0 40 80
SCALE IN FEET

4084075106030.DWG 1.0
20081015 1526

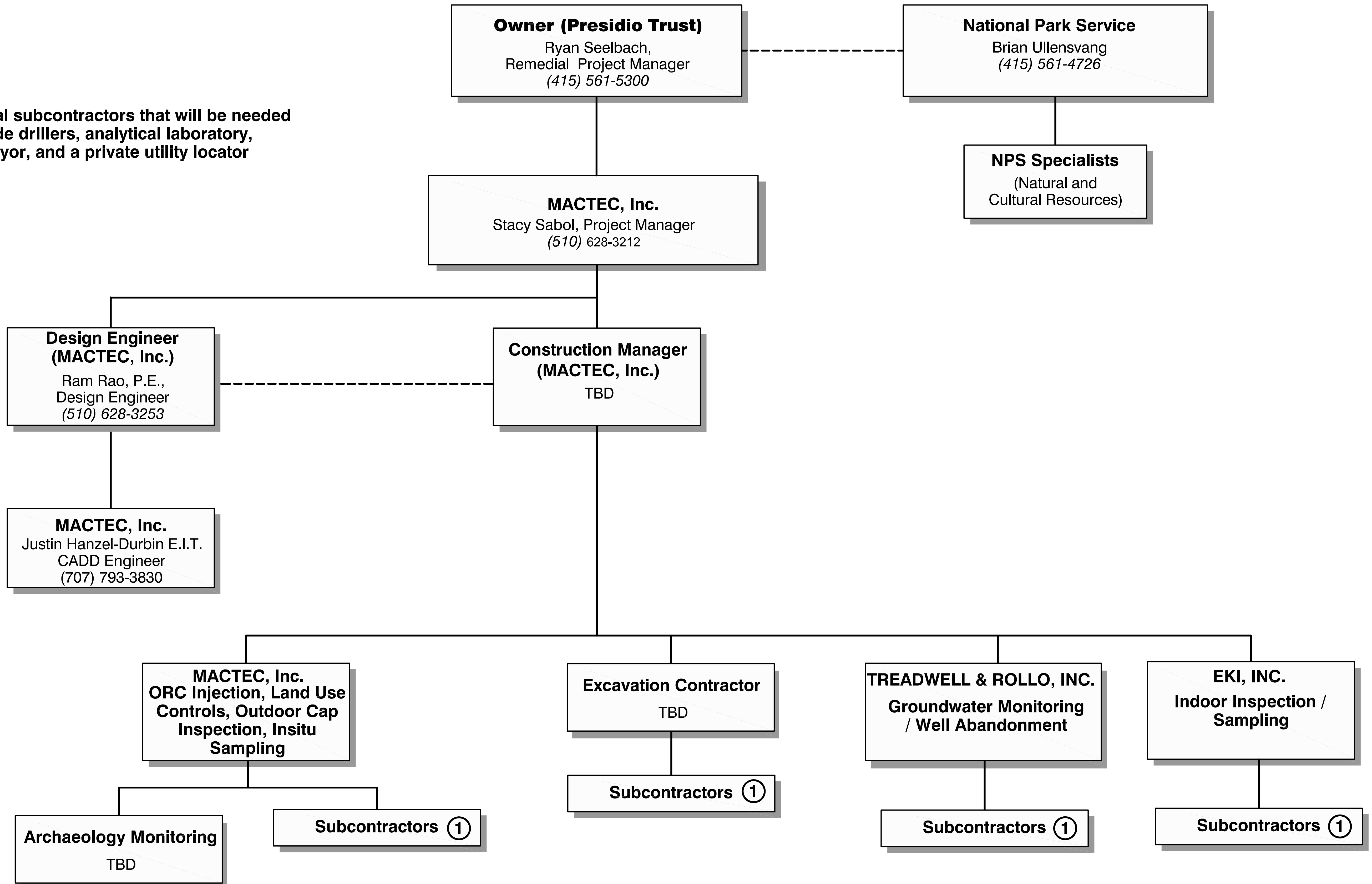
MACTEC

ASSUMED EXCAVATION AREAS, LAND USE CONTROL AREAS, AND GROUNDWATER MONITORING WELLS
PRESIDIO BUILDING 207/231 AREA
PRESIDIO SAN FRANCISCO
SAN FRANCISCO, CALIFORNIA

FIGURE:
**1-8**

| DRAWN | JOB NUMBER | CHECKED | CHECKED DATE | APPROVED | APPROVED DATE |
|---|---|---|---|---|---|
| JHD | 4084075106 | JHD | 10/2008 | RR | 10/2008 |

**NOTE:**
1 Typical subcontractors that will be needed include drlllers, analytical laboratory, surveyor, and a private utility locator




MACTEC

**ORGANIZATION CHART OF CORRECTIVE ACTION CONTRACTING**
BUILDING 207/231 AREA
PRESIDIO OF SAN FRANCISCO
SAN FRANCISCO, CALIFORNIA

FIGURE **1-9**

| DRAWN | JOB NUMBER | CHECKED | CHCK'D DATE | APPROVED | APPRV'D DATE |
|---|---|---|---|---|---|
| JHD | 4084075106 07 | JHD | 10/2008 | RR | 10/2008 |

4084075106056.DWG 0.0
20081016.1621


## LEGEND

| | |
|---|---|
| SOIL REMEDIAL UNITS | |
| TOPOGRAPHIC CONTOUR | 24 |
| PERIMETER FENCE | |
| ASSUMED EXCAVATION AREA | |
| GEOARCHAEOLOGICAL TRENCH LOCATION (FOR TRENCH LOGS, SEE TECHNICAL SPECIFICATIONS; ATTACHMENT 1) | |
| SOIL BORING LOCATION | |
| EXCAVATION SAMPLE LOCATION | △ |
| FORMER STRUCTURE OR FEATURE | |

NOTES:

1. CONTRACTOR TO MAINTAIN A 1 FT SEPARATION OF TOP OF EXCAVATION FROM CALTRANS RIGHT OF WAY BOUNDARIES.

2. EXCAVATION LIMIT AND DEPTH SUBJECT TO CHANGE IF OVER-EXCAVATION IS REQUIRED.

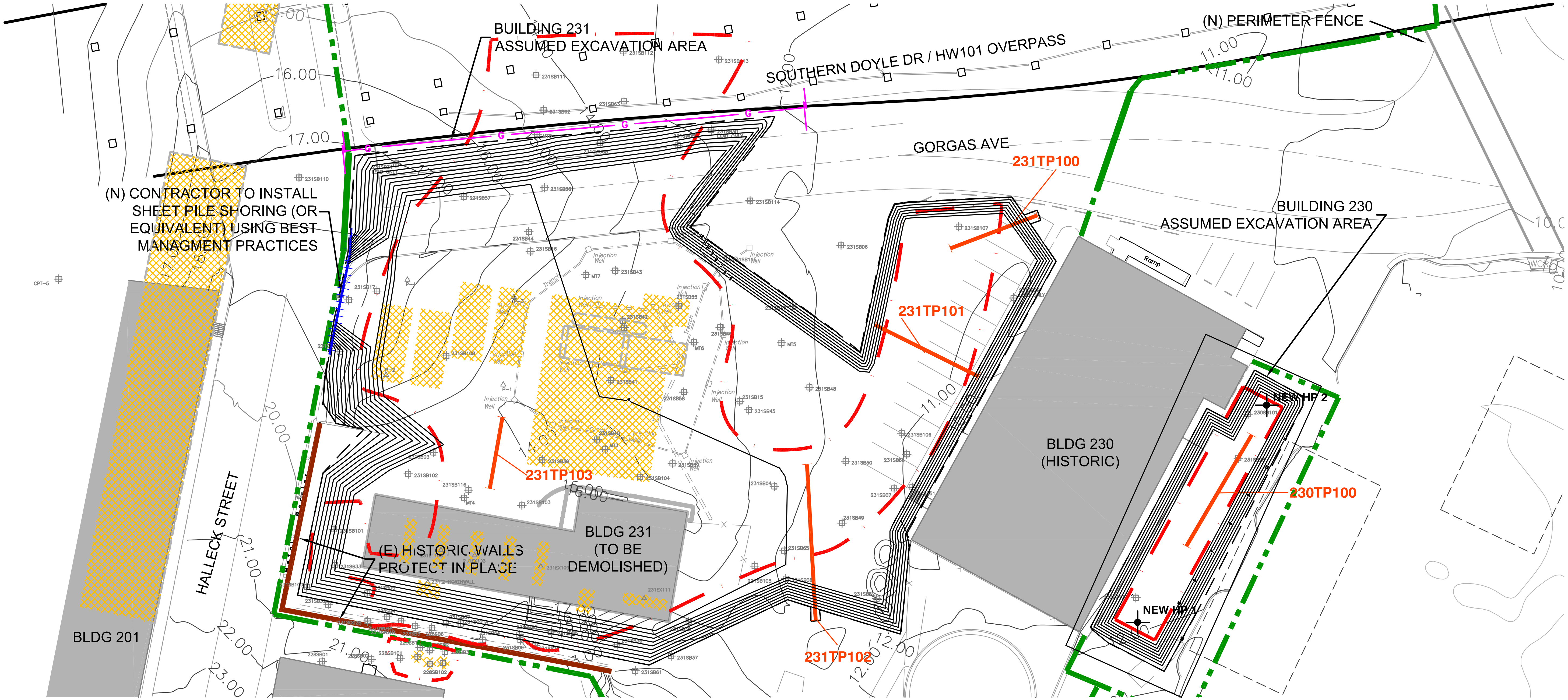
4084075106058.DWG 20.0
20081016.0915

MACTEC

PROPOSED EXCAVATION PLAN
NORTH AREA
PRESIDIO BUILDING 207/231 AREA
PRESIDIO OF SAN FRANCISCO
SAN FRANCISCO, CALIFORNIA

FIGURE
2-2A

| DRAWN | JOB NUMBER | CHECKED | CHECKED DATE | APPROVED | APPROVED DATE |
|---|---|---|---|---|---|
| JHD | 4084075106 | JHD | 10/2008 | RR | 10/2008 |




LEGEND

NOTES:

1. CONTRACTOR TO MAINTAIN A 3 FT SEPARATION FROM THE GAS LINE RUNNING PARALLEL TO THE SOUTHERN DOYLE DRIVE OVERPASS.

2. EXCAVATION LIMIT AND DEPTH SUBJECT TO CHANGE IF OVER EXCAVATION IS REQUIRED.

SOIL REMEDIAL UNITS

TOPOGRAPHIC CONTOUR — 24

PERIMETER FENCE

ASSUMED EXCAVATION AREA

GEOARCHAEOLOGICAL TRENCH LOCATION (FOR TRENCH LOGS, SEE TECHNICAL SPECIFICATIONS; ATTACHMENT 1)

EXCAVATION SHORING

SOIL BORING LOCATION

APPROXIMATE HYDROPUNCH LOCATION S — NEW HP-1

EXCAVATION SAMPLE LOCATION

FORMER STRUCTURE OR FEATURE

GAS LINE — G

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MACTEC

PROPOSED EXCAVATION PLAN
NORTH AREA
PRESIDIO BUILDING 207/231 AREA
PRESIDIO OF SAN FRANCISCO
SAN FRANCISCO, CALIFORNIA

FIGURE
2-2B

| DRAWN | JOB NUMBER | CHECKED | CHECKED DATE | APPROVED | APPROVED DATE |
|---|---|---|---|---|---|
| JHD | 4084075106 | JHD | 10/2008 | RR | 10/2008 |


LEGEND

PIEZOMETER - SHALLOW SAND

MONITORING WELL - SHALLOW SAND

MONITORING WELL - INTERMEDIATE ZONES

MONITORING WELL - DEEP ZONES

SVE AND GROUNDWATER INJECTION (IW) OR EXTRACTION (EW) WELL

TO BE ABANDONED BY OVERDILLING AND BACK FILLING WITH BENTONITE AND FINISH SURFACE WITH CONCRETE

WITHIN LANDSCAPE RESTORATION AREA- TO BE ABANDONED BY OVERDILLING AND BACK FILLING WITH BENTONITE ONLY

OUTSIDE OF QUARTERMASTER REACH MARSH ZONE- TO BE ABANDONED BY OVERDRILLING AND BACK FILLING WITH NEAT CEMENT AND FINISH SURFACE WITH CONCRETE

N

20 0 20 40

SCALE IN FEET

MACTEC

WELL ABANDONMENT PLAN
PRESIDIO BUILDING 207/231 AREA
PRESIDIO SAN FRANCISCO
SAN FRANCISCO, CALIFORNIA

FIGURE:

3-1

| DRAWN | JOB NUMBER | CHECKED | CHECKED DATE | APPROVED | APPROVED DATE |
|---|---|---|---|---|---|
| JHD | 4084075106 | JHD | 10/2008 | RR | 10/2008 |

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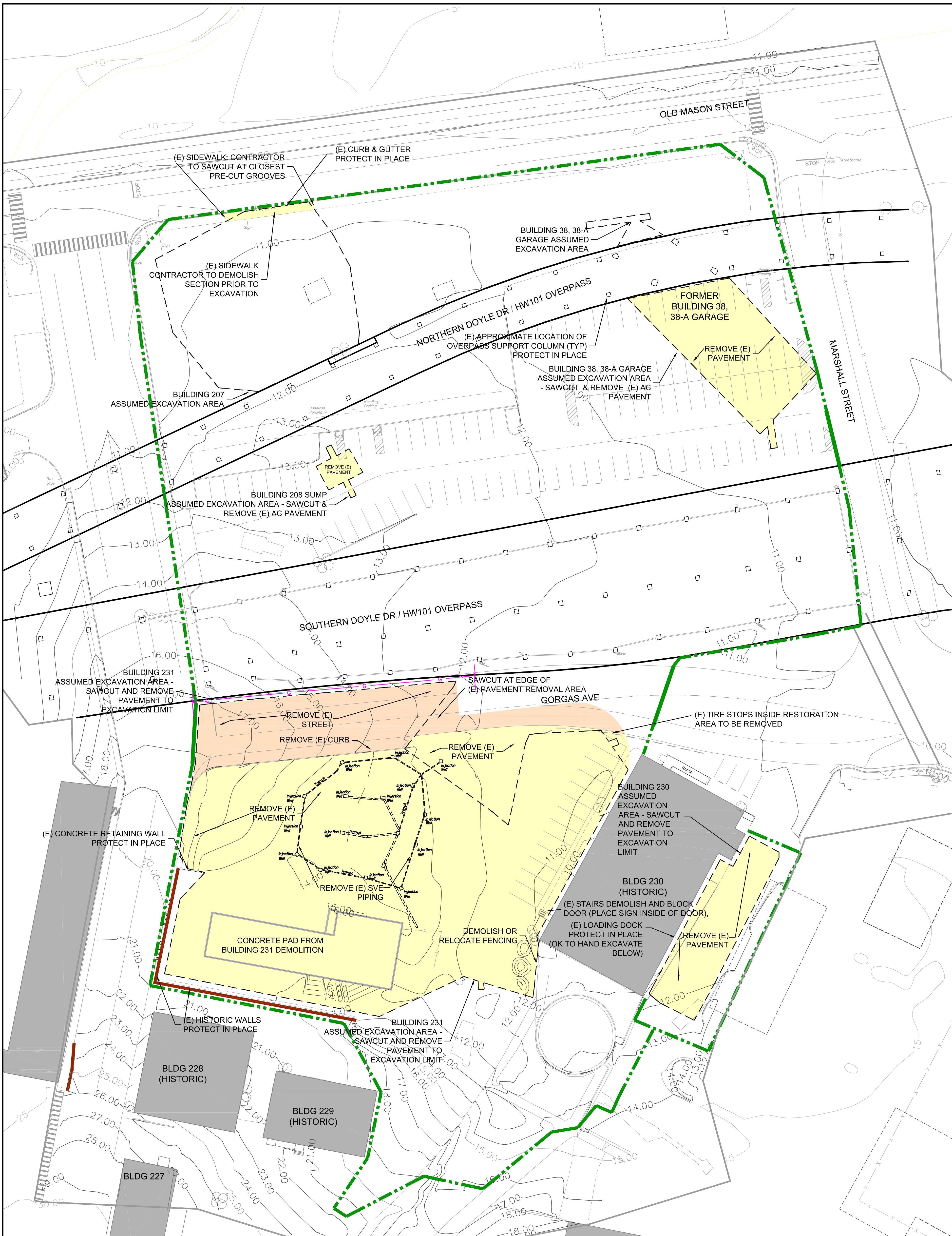


LEGEND

| | |
|---|---|
| TOPOGRAPHIC CONTOUR | 24 |
| PERIMETER FENCE | |
| ASSUMED EXCAVATION AREA | |
| HISTORIC WALL | |
| AC AND AB REMOVAL AREA (PARKING LOT) | |
| STREET REMOVAL AREA | |

NOTES:

1. CONTRACTOR TO SAWCUT & REMOVE PAVEMENT (INCLUDING WHEEL STOPS) AS SHOWN BY YELLOW AND ORANGE SHADING.

2. CONTRACTOR TO RECYCLE ALL DEMOLISHED MATERIALS IF POSSIBLE. ASSUME NO MATERIALS TO BE SAVED UNLESS NOTED.

3. CONTRACTOR SHALL COORDINATE WITH TRUST'S UTILITY DEPT. FOR CONFORMATION OF UTILITY LOCATIONS A MINIMUM OF 2 WEEKS IN ADVANCE OF CONSTRUCTION.

N

30 0 30 60
SCALE IN FEET

MACTEC

DEMOLITION PLAN
PRESIDIO BUILDING 207/231 AREA
PRESIDIO SAN FRANCISCO
SAN FRANCISCO, CALIFORNIA

FIGURE
3-2

| DRAWN | JOB NUMBER | CHECKED | CHECKED DATE | APPROVED | APPROVED DATE |
|---|---|---|---|---|---|
| JHD | 4084075106 07 | JHD | 10/2008 | RR | 10/2008 |

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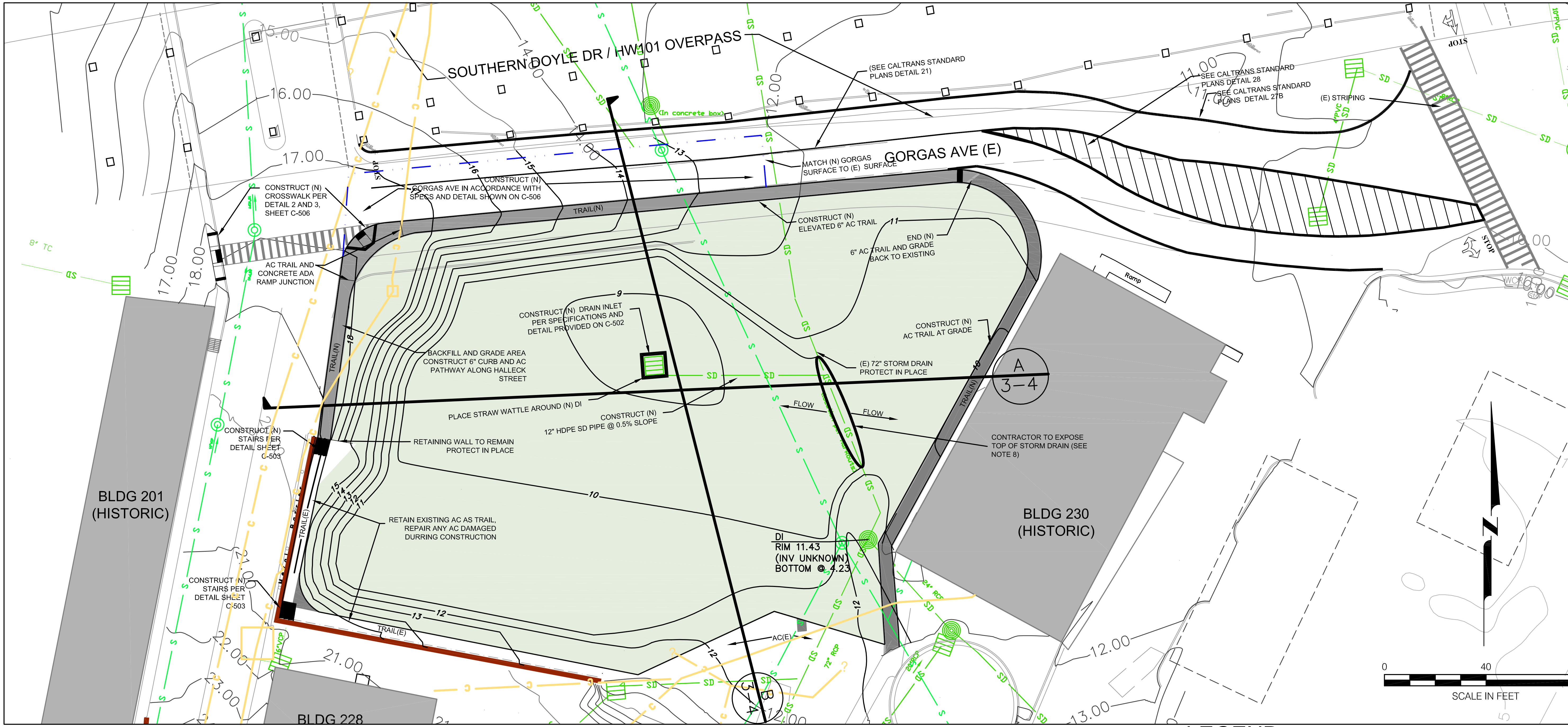


## LEGEND

HISTORIC WALL

(N) TOPOGRAPHIC CONTOUR — 24

(E) TOPOGRAPHIC CONTOUR — 24

LIMITS OF GORGAS AVE RECONSTRUCTION

NEW AC PATH AT GRADE

NEW RAISED AC PATH

RE-VEGETATION AREA

## CONSTRUCTION NOTES

1. SEE CONSTRUCTION DWG C-122 FOR PLAN AND PROFILE OF (N) GORGAS AVENUE AND (N) TRAIL.
2. SEE CONSTRUCTION DWG C-122 FOR (N) PVMT MARKINGS.
3. NEW GORGAS AVENUE SURFACE GRADE TO MATCH EXISTING GRADE AT THE JUNCTION WITH EXISTING STREET SURFACE.
4. CONSTRUCT (N) HANDICAPPED RAMPS PER CONSTRUCTION DRAWINGS DETAILS 2 AND 3 SHEET C-506.
5. ALL EXPOSED BACKFILL SURFACES SHALL BE REVEGITATED ACCORDING TO PRE APPROVED TRUST/NPS PLAN.
6. CONSTRUCT NEW AC TRAIL. (N) GORGAS AVENUE TRAIL SHALL SLOPE TO THE NORTH. (N) TRAIL ADJACENT TO BUILDING 230 SHALL SLOPE TOWARD DRAINAGE DITCH TO THE EAST.
7. (N) AC TRAIL SHALL CONFORM TO (E) AC WHERE (N) AC TRAIL MEETS (E) AS SHOWN. PROTECT (E) AC IN PLACE AS (E) AC SHALL SERVE AS TRAIL.
8. IN THE VICINITY OF THE 72" STORM DRAIN THE FINAL SURFACE ELEVATION WILL BE RESTORED TO 10 FEET (NAVD 88). A PORTION OF THE 72" STORM DRAIN WILL BE EXPOSED PROVIDED ITS TOP IS ABOVE THE RESTORED ELEVATION.

MACTEC

GRADING PLAN
FOR BUILDING 231 AREA
PRESIDIO BUILDING 207/231 AREA
PRESIDIO OF SAN FRANCISCO
SAN FRANCISCO, CALIFORNIA

FIGURE
3-3

| DRAWN | JOB NUMBER | CHECKED | CHECKED DATE | APPROVED | APPROVED DATE |
|---|---|---|---|---|---|
| JHD | 4084075106 07 | JHD | 10/2008 | RR | 10/2008 |

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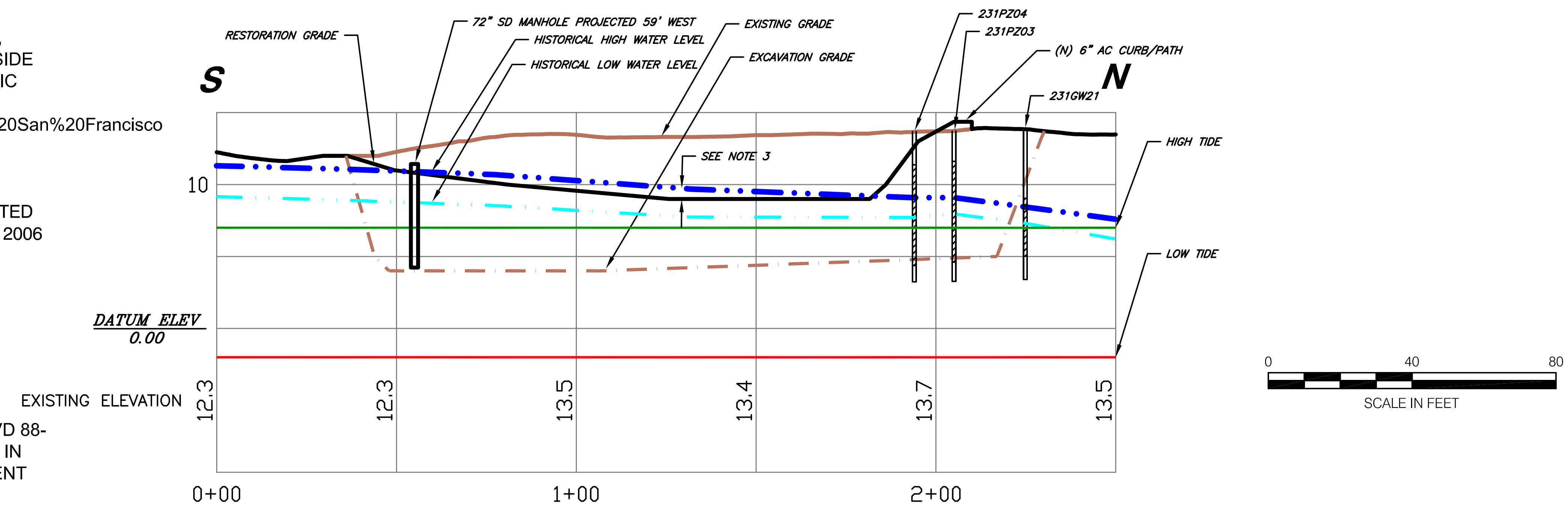
20081015.1622

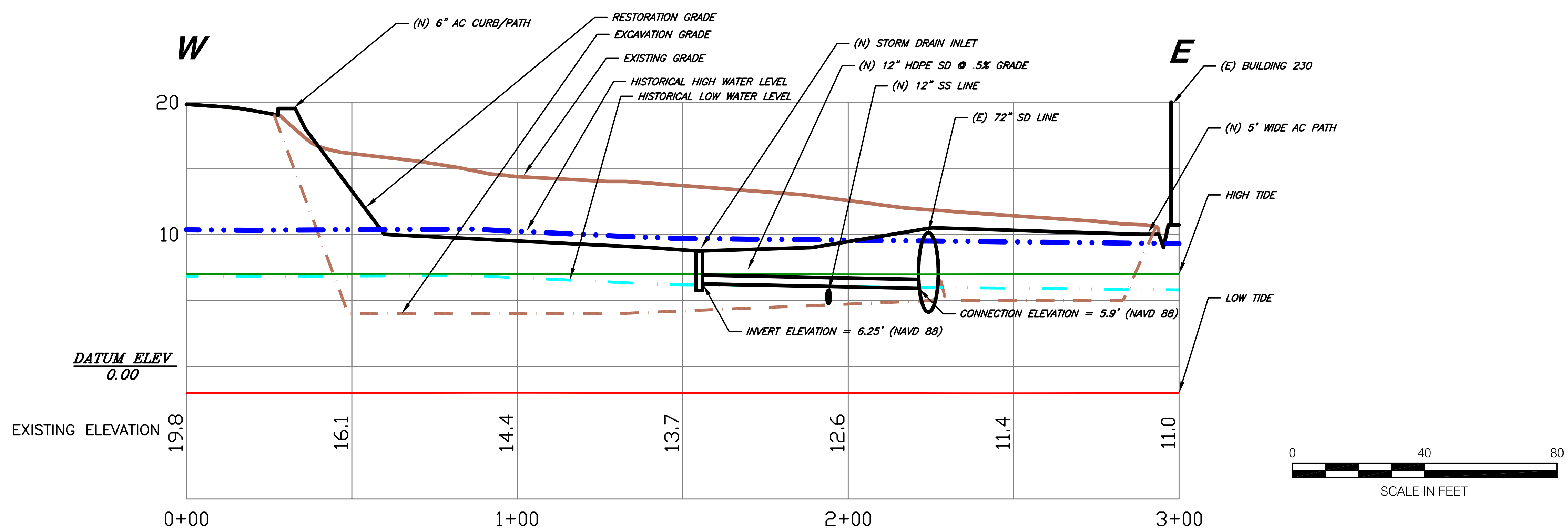
**NOTES:**

1. HIGH AND LOW TIDE ELEVATION DATA FROM 2006-2007, SOURCE; TIDE GAGE STATION #9414290(NORTH EAST SIDE OF NPS WHARF) NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION WEB SITE. http://co-ops.nos.noaa.gov/data_menu.shtml?stn=9414290%20San%20Francisco ,%20CA&type=Historic+Tide+Data
2. HISTORICAL HIGH WATER LEVEL CONTOURS WERE DEVELOPED USING THE HIGHEST AND LOWEST REPORTED GROUNDWATER ELEVATION DATA FROM 2001 THROUGH 2006 FOUND IN THE PRESIDIO SEMI ANNUAL GROUNDWATER MONITORING REPORT 1ST AND 2ND QUARTERS 2006 (TREADWELL AND ROLLO, OCTOBER 2006)
3. THE DIFFERENCE BETWEEN HIGH WATER LEVEL AND RESTORATION GRADE DOES NOT EXCEED 1 FT.
4. VERTICAL DATUM FOR THESE CROSS-SECTIONS IS NAVD 88-US SURVEY FEET; ELEVATION MEASUREMENTS TAKEN IN PLLW WERE CONVERTED TO NAVD 88 TO BE CONSISTENT WITH TOPOGRAPHIC SURVEY DATA. CONVERSION: NAVD 88 = PLLW-0.37




NORTH – SOUTH CROSS SECTION B 3–4

SCALE: HORIZ : 1" = 40'
VERT : 1" = 10'




EAST – WEST CROSS SECTION A 3–4

SCALE: HORIZ : 1" = 40'
VERT : 1" = 10'

## LEGEND

- LOW TIDE ①
- HIGH TIDE ①
- EXISTING GRADE
- RESTORATION GRADE
- EXCAVATION GRADE
- HISTORIC LOW GROUNDWATER LEVELS ②
- HISTORIC HIGH GROUNDWATER LEVELS ②

MACTEC

CROSS SECTIONS
BUILDING 231 RESTORATION AREA
PRESIDIO BUILDING 207/231 AREA
PRESIDIO OF SAN FRANCISCO
SAN FRANCISCO, CALIFORNIA

FIGURE **3-4**

| DRAWN | JOB NUMBER | CHECKED | CHECKED DATE | APPROVED | APPROVED DATE |
|---|---|---|---|---|---|
| JHD | 4084075106 07 | JHD | 10/2008 | RR | 10/2008 |

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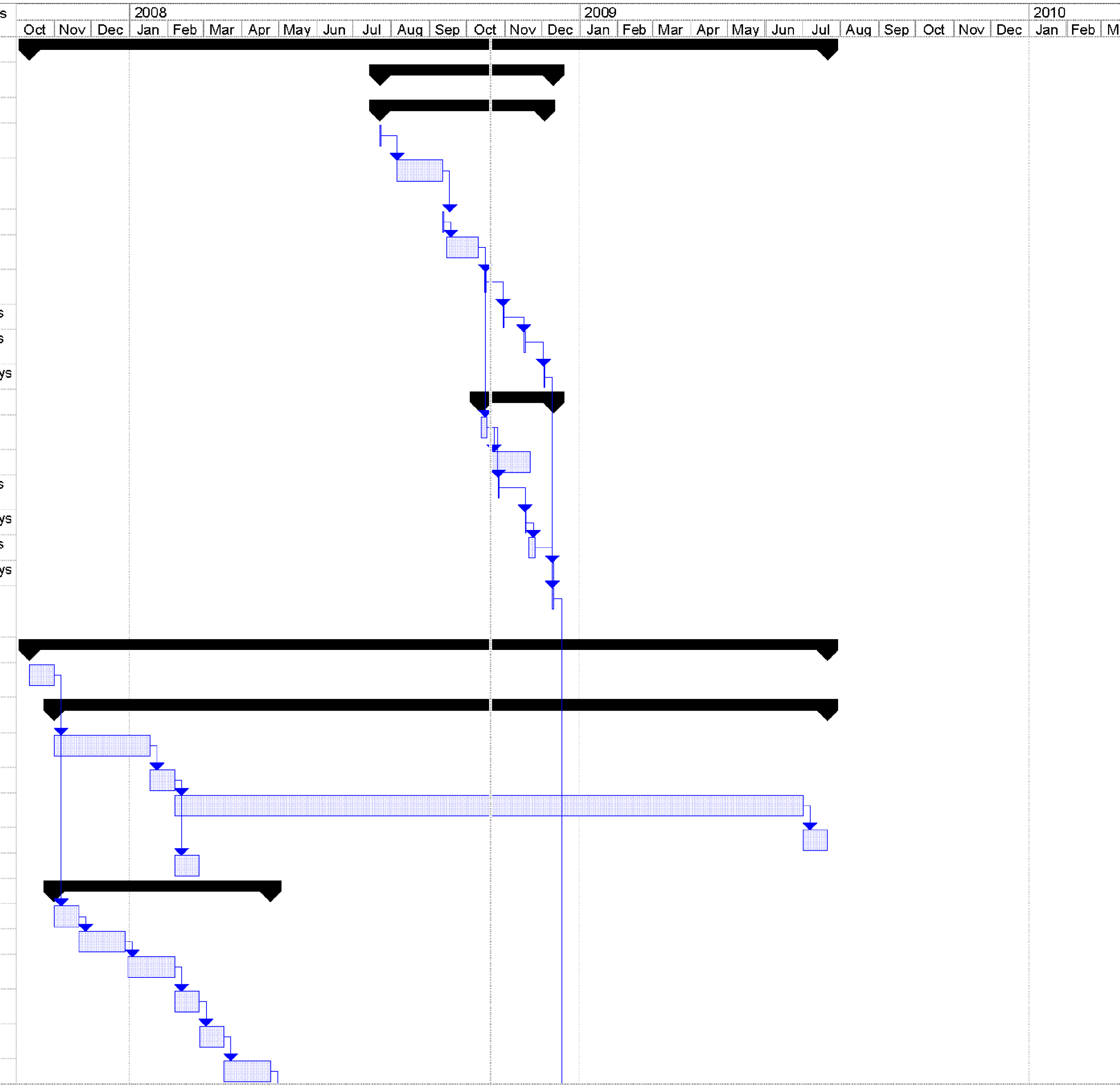
20071018.1711

Figure 6-1
Corrective Action Implementation Schedule

| ID | Info | Task Name | Start | Finish | Predecessors |
|---|---|---|---|---|---|
| 1 | | **207/231 Corrective Action Implementation** | **Fri 10/12/07** | **Tue 7/21/09** | |
| 2 | | **Finalize Design for Corrective Action Implementation** | **Wed 7/23/08** | **Wed 12/10/08** | |
| 3 | | **Corrective Action Implementation Work Plan** | **Wed 7/23/08** | **Wed 12/3/08** | |
| 4 | | Submit the Draft Final Corrrective Action Implementation Work Plan for Review by Trust | Wed 7/23/08 | Wed 7/23/08 | |
| 5 | | Stakeholder Review of Draft Final Corrective Action Implementation Work Plan, Get Comments, Propose Responses | Wed 8/6/08 | Thu 9/11/08 | 4 |
| 6 | | Stakeholder Meeting | Fri 9/12/08 | Fri 9/12/08 | 5 |
| 7 | | Revise Based on Stakeholder Input and Submit for Review by NPS, Trust, Water Board, Stakeholders | Mon 9/15/08 | Fri 10/10/08 | 6 |
| 8 | | Submittal of Draft Final Work Plan to NPS, Trust, Water Board, and Stakeholders | Thu 10/16/08 | Thu 10/16/08 | 7FS+3 days |
| 9 | | Agency Comments to Work Plan | Fri 10/31/08 | Fri 10/31/08 | 8FS+10 days |
| 10 | | Final Work Plan Submittal to NPS, Water Board, and Stakeholders | Mon 11/17/08 | Mon 11/17/08 | 9FS+10 days |
| 11 | | Agency Approval of Final Work Plan | Wed 12/3/08 | Wed 12/3/08 | 10FS+11 days |
| 12 | | **Trust Procurement-Excavation** | **Mon 10/13/08** | **Wed 12/10/08** | |
| 13 | | Submit Construction Documents to Excavation Contractors to Procure Bid | Mon 10/13/08 | Fri 10/17/08 | 7 |
| 14 | | N Squared and Project Review | Mon 10/20/08 | Fri 11/21/08 | 13 |
| 15 | | Pre Bid Meeting to Answer Questions of Contractors | Mon 10/27/08 | Mon 10/27/08 | 13FS+5 days |
| 16 | | Bid Receipt from Excavation Contractors | Tue 11/18/08 | Tue 11/18/08 | 15FS+15 days |
| 17 | | Bid Review for Excavation Contractors | Fri 11/21/08 | Tue 11/25/08 | 16FS+2 days |
| 18 | | Trust Financial Approvals to Excavation Contractor | Wed 12/10/08 | Wed 12/10/08 | 17FS+10 days |
| 19 | | Trust Provide Contracts to Other Site Contractors (MACTEC, EKI, and T&R), Conduct Building 231 Demolition and Well Abandonment | Wed 12/10/08 | Wed 12/10/08 | 17FS+10 days,11 |
| 20 | | **RU 228 and Historic Wall Interface Corrective Action** | **Fri 10/12/07** | **Tue 7/21/09** | |
| 21 | | **MACTEC and EKI Procurement of Subcontractors** | Fri 10/12/07 | Wed 10/31/07 | |
| 22 | | **In Situ Remediation at Historic Wall Interface (MACTEC)** | **Thu 11/1/07** | **Tue 7/21/09** | |
| 23 | | RU 231 Sampling, RegenOx Injection, Survey, Monitoring | Thu 11/1/07 | Thu 1/17/08 | 21 |
| 24 | | RUs 231 and 228 ORC Injection, Survey | Fri 1/18/08 | Wed 2/6/08 | 23 |
| 25 | | RUs 231 and 228 Injection Effectiveness Monitoring and Assessment | Thu 2/7/08 | Wed 7/1/09 | 24 |
| 26 | | RUs 231 and 228 In Situ Confirmation Sampling | Thu 7/2/09 | Tue 7/21/09 | 25 |
| 27 | | MACTEC - Exterior Cap Inspection and Documentation | Thu 2/7/08 | Tue 2/26/08 | 24 |
| 28 | | **Indoor Air and Cap Assessment (EKI)** | **Thu 11/1/07** | **Thu 4/24/08** | |
| 29 | | Soil Gas Sampling, Survey | Thu 11/1/07 | Tue 11/20/07 | 21 |
| 30 | | Soil Gas Data Assessment | Wed 11/21/07 | Fri 12/28/07 | 29 |
| 31 | | Indoor Air Monitoring (Contingent on Data Assessment) | Mon 12/31/07 | Wed 2/6/08 | 30 |
| 32 | | Indoor Cap Inspection (Contingent on Data Assessment) | Thu 2/7/08 | Tue 2/26/08 | 31 |
| 33 | | Indoor Cap Improvements (Contingent on Data Assessment) | Wed 2/27/08 | Mon 3/17/08 | 32 |
| 34 | | Indoor Air and Cap Assessment Reporting | Tue 3/18/08 | Thu 4/24/08 | 33 |




Project: Figure 6-1 207-231 Schedule
Date: Mon 10/20/08

Task | Progress | Summary | External Tasks | Deadline
Split | Milestone | Project Summary | External Milestone



| | |
|---|---|
| DRAWN: TJH | PROJECT NO: 4084075106 07 |
| ENGINEER: | SCALE: |
| CHECKED: RR | APPROVED: MLS |
| DATE: 10/2008 | DATE: 10/2008 |

MACTEC

Corrective Action Implementation Work Plan
Presidio Building 207/231 Area
Presidio of San Francisco
San Francisco, California

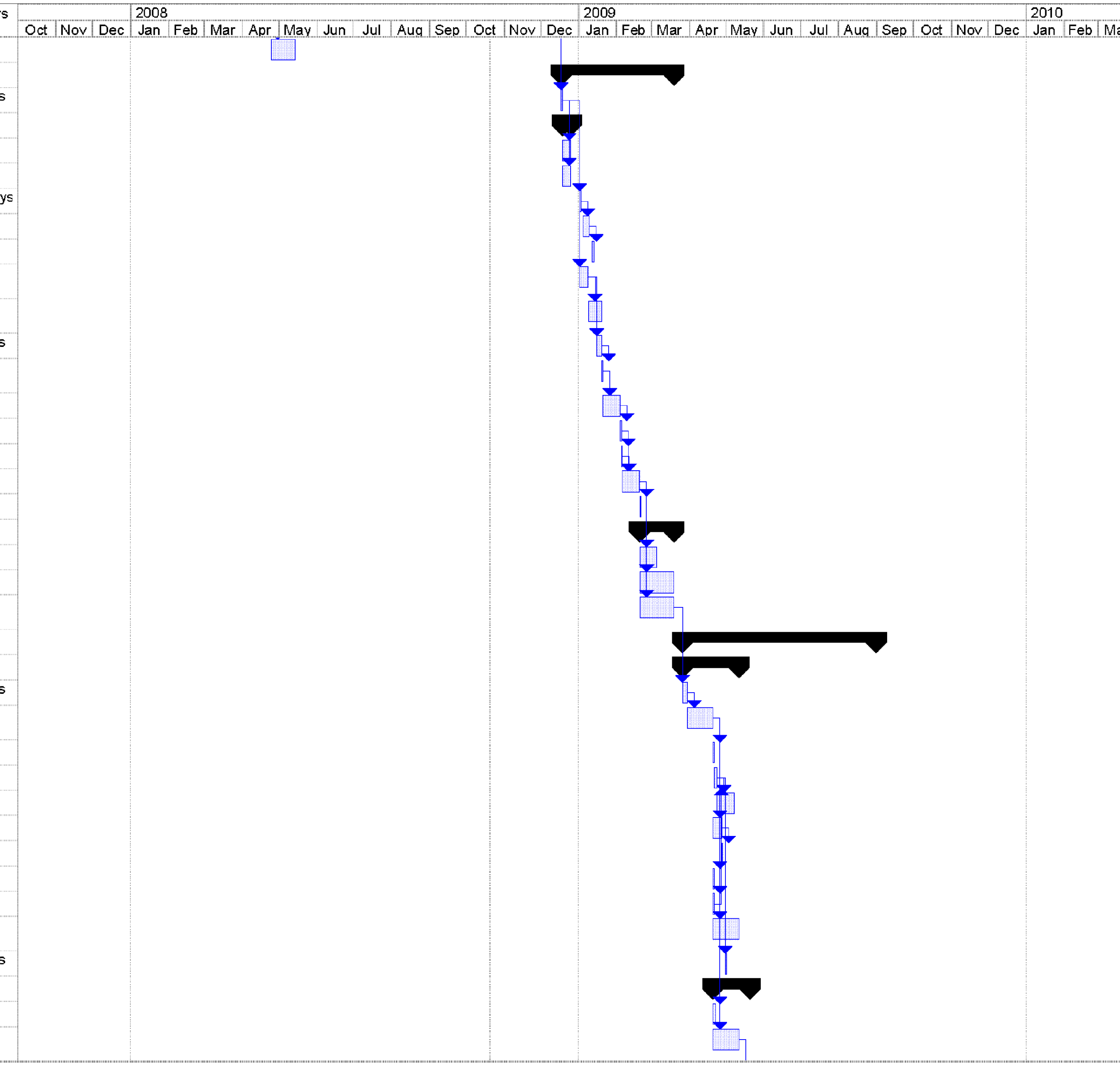
Corrective Action Implementation Schedule

FIGURE 1 of 4
**6-1**

ScheduleP1.mxd - 10/22/08

Figure 6-1
Corrective Action Implementation Schedule

| ID | Task Name | Start | Finish | Predecessors |
|---|---|---|---|---|
| 35 | Exterior Cap Improvements | Fri 4/25/08 | Wed 5/14/08 | 34 |
| 36 | **Pre-Excavation** | **Thu 12/18/08** | **Thu 3/19/09** | |
| 37 | Notice to Proceed | Thu 12/18/08 | Thu 12/18/08 | 19FS+5 days |
| 38 | **Notification/Permits:** | **Fri 12/19/08** | **Thu 12/25/08** | |
| 39 | BAAQMD Notification | Fri 12/19/08 | Thu 12/25/08 | 37 |
| 40 | Presidio Trust Excavation Permit | Fri 12/19/08 | Thu 12/25/08 | 37 |
| 41 | Mark Out For USA-Site Wide | Fri 1/2/09 | Fri 1/2/09 | 37FS+10 days |
| 42 | Trust Utility Mark-Out/Review-Site Wide | Mon 1/5/09 | Fri 1/9/09 | 41 |
| 43 | USA Notification | Mon 1/12/09 | Tue 1/13/09 | 42 |
| 44 | Contractor Pre-Construction Submittal Submission - Plans/Equipment/Product/Qualifications | Fri 1/2/09 | Thu 1/8/09 | 37FS+10 days |
| 45 | Contractor Pre-Construction Submittal Review - Plans/Equipment/Product/Qualifications | Fri 1/9/09 | Mon 1/19/09 | 44 |
| 46 | Contractor Pre-Construction Site Survey Staking | Fri 1/16/09 | Mon 1/19/09 | 44FS+5 days |
| 47 | Contractor Pre-Construction Site Survey Staking Review Meeting | Tue 1/20/09 | Tue 1/20/09 | 46 |
| 48 | Pre-Construction Contractor Site Survey | Wed 1/21/09 | Tue 2/3/09 | 47 |
| 49 | Pre-Construction Meeting | Wed 2/4/09 | Wed 2/4/09 | 48 |
| 50 | Pre-Construction Safety Meeting | Thu 2/5/09 | Thu 2/5/09 | 49 |
| 51 | Mobilization | Fri 2/6/09 | Thu 2/19/09 | 49,50 |
| 52 | Project Kick Off Meeting | Fri 2/20/09 | Fri 2/20/09 | 51 |
| 53 | **Temporary Controls Installation** | **Fri 2/20/09** | **Thu 3/19/09** | |
| 54 | Temporary Controls Installation | Fri 2/20/09 | Thu 3/5/09 | 51 |
| 55 | Utility Decomissioning and Rerouting Work | Fri 2/20/09 | Thu 3/19/09 | 51 |
| 56 | Installation of New Water Line for Building 230 (Potable Service), Includes Disinfection | Fri 2/20/09 | Thu 3/19/09 | 51 |
| 57 | **Excavation** | **Fri 3/27/09** | **Mon 8/31/09** | |
| 58 | **RU 230 Corrective Action** | **Fri 3/27/09** | **Mon 5/11/09** | |
| 59 | Pavement Removal | Fri 3/27/09 | Mon 3/30/09 | 56FS+5 days |
| 60 | Excavation, Archaeological Montioring, Confirmation Sampling, Analysis and Review | Tue 3/31/09 | Mon 4/20/09 | 59 |
| 61 | Excavation Record Survey | Tue 4/21/09 | Tue 4/21/09 | 60 |
| 62 | Hydro Punch Installation and Sampling | Wed 4/22/09 | Thu 4/23/09 | 67 |
| 63 | Hydropunch Sample Analysis | Fri 4/24/09 | Thu 5/7/09 | 62 |
| 64 | Waste Profile and Analysis | Tue 4/21/09 | Mon 4/27/09 | 60 |
| 65 | Transportation and Disposal | Tue 4/28/09 | Tue 4/28/09 | 64 |
| 66 | Backfill, Compaction and Grading | Tue 4/21/09 | Tue 4/21/09 | 60 |
| 67 | AC Placement | Tue 4/21/09 | Tue 4/21/09 | 60 |
| 68 | Reinstall Water Line from Gorgas on East Side of Building 231 | Tue 4/21/09 | Mon 5/11/09 | 60 |
| 69 | Final Record Survey | Fri 5/1/09 | Fri 5/1/09 | 62FS+5 days |
| 70 | **RU 38 Corrective Action** | **Tue 4/21/09** | **Wed 5/20/09** | |
| 71 | Pavement and Landscape Removal | Tue 4/21/09 | Wed 4/22/09 | 60 |
| 72 | Excavation, Archaeological Montioring, Confirmation Sampling, Analysis and Review | Tue 4/21/09 | Mon 5/11/09 | 60 |




Project: Figure 6-1 207-231 Schedule
Date: Mon 10/20/08

Task | Split | Progress | Milestone | Summary | Project Summary | External Tasks | External Milestone | Deadline



| | | | |
|---|---|---|---|
| DRAWN: TJH | PROJECT NO: 4084075106 07 | | |
| ENGINEER: | SCALE: | | |
| CHECKED: RR | APPROVED: MLS | | |
| DATE: 10/2008 | DATE: 10/2008 | | |

MACTEC

Corrective Action Implementation Work Plan
Presidio Building 207/231 Area
Presidio of San Francisco
San Francisco, California

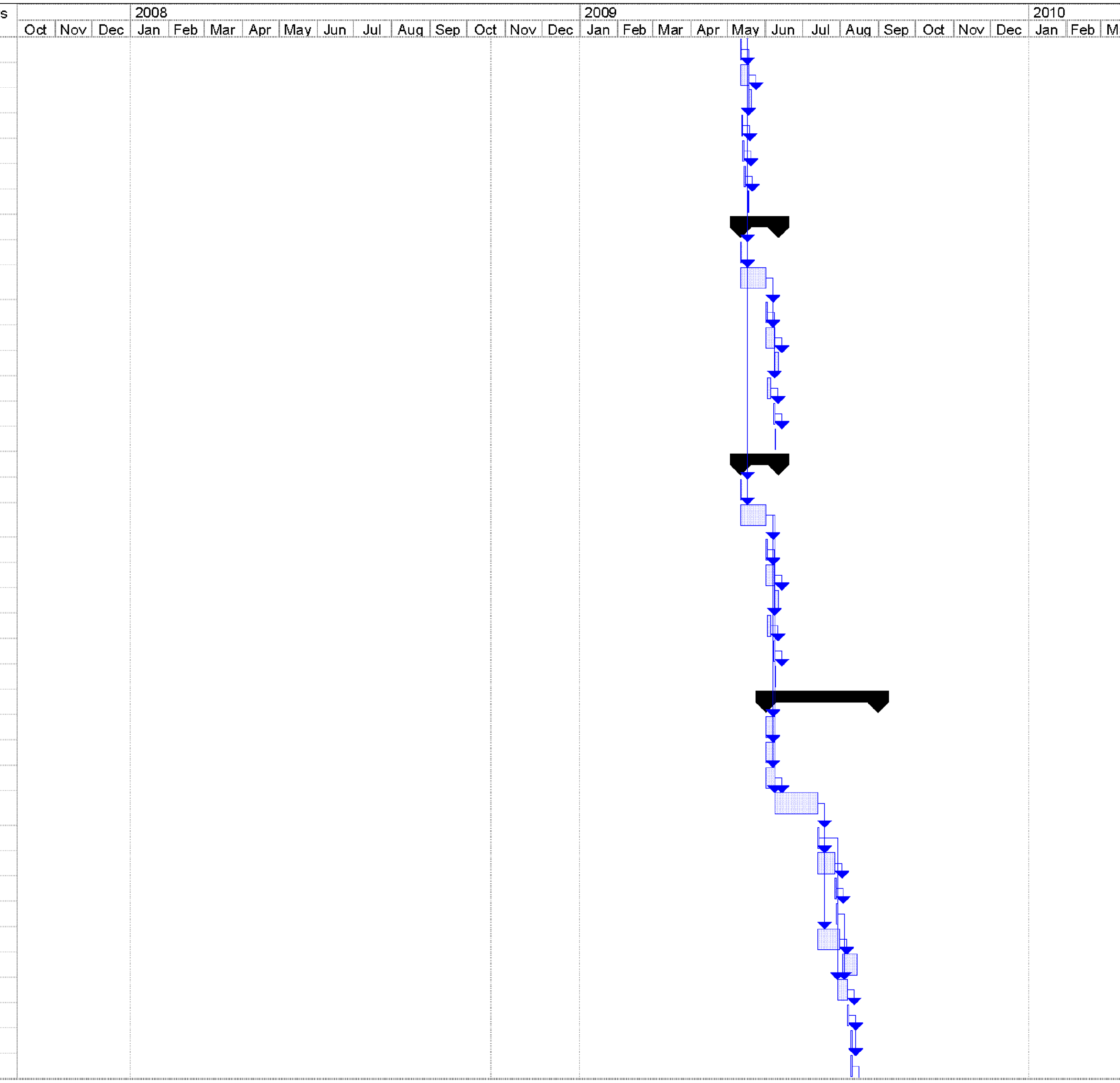
Corrective Action Implementation Schedule

FIGURE 2 of 4
6-1

SchedulePi2.mxd - 10/22/08

Figure 6-1
Corrective Action Implementation Schedule

| ID | Task Name | Start | Finish | Predecessors |
|---|---|---|---|---|
| 73 | Excavation Record Survey | Tue 5/12/09 | Tue 5/12/09 | 72 |
| 74 | Waste Profile and Analysis | Tue 5/12/09 | Mon 5/18/09 | 72 |
| 75 | Transportation and Disposal | Tue 5/19/09 | Wed 5/20/09 | 74 |
| 76 | Backfill, Compaction and Grading | Wed 5/13/09 | Wed 5/13/09 | 73 |
| 77 | Paving | Thu 5/14/09 | Thu 5/14/09 | 76 |
| 78 | Final Record Survey | Fri 5/15/09 | Fri 5/15/09 | 77 |
| 79 | Landscape Restoration | Mon 5/18/09 | Mon 5/18/09 | 78 |
| 80 | **RU 207 Corrective Action** | **Tue 5/12/09** | **Thu 6/11/09** | |
| 81 | Pavement and Landscape Removal | Tue 5/12/09 | Tue 5/12/09 | 72 |
| 82 | Excavation, Archaeological Montioring, Confirmation Sampling, Analysis and Review | Tue 5/12/09 | Mon 6/1/09 | 72 |
| 83 | Excavation Record Survey | Tue 6/2/09 | Tue 6/2/09 | 82 |
| 84 | Waste Profile and Analysis | Tue 6/2/09 | Mon 6/8/09 | 82 |
| 85 | Transportation and Disposal | Tue 6/9/09 | Thu 6/11/09 | 84 |
| 86 | Backfill, Compaction and Grading | Wed 6/3/09 | Fri 6/5/09 | 83 |
| 87 | Final Record Survey | Mon 6/8/09 | Mon 6/8/09 | 86 |
| 88 | Landscape Restoration | Tue 6/9/09 | Tue 6/9/09 | 87 |
| 89 | **208 Portion of RU 207 Corrective Action** | **Tue 5/12/09** | **Thu 6/11/09** | |
| 90 | Pavement Removal | Tue 5/12/09 | Tue 5/12/09 | 72 |
| 91 | Excavation, Archaeological Montioring, Confirmation Sampling, Analysis and Review | Tue 5/12/09 | Mon 6/1/09 | 72 |
| 92 | Excavation Record Survey | Tue 6/2/09 | Tue 6/2/09 | 91 |
| 93 | Waste Profile and Analysis | Tue 6/2/09 | Mon 6/8/09 | 91 |
| 94 | Transportation and Disposal | Tue 6/9/09 | Thu 6/11/09 | 93 |
| 95 | Backfill, Compaction and Grading | Wed 6/3/09 | Fri 6/5/09 | 92 |
| 96 | AC Placement | Mon 6/8/09 | Mon 6/8/09 | 95 |
| 97 | Final Record Survey | Tue 6/9/09 | Tue 6/9/09 | 96 |
| 98 | **RU 231 Corrective Action** | **Tue 6/2/09** | **Mon 8/31/09** | |
| 99 | Pavement Removal | Tue 6/2/09 | Mon 6/8/09 | 91 |
| 100 | Reroute Fire System for Buuilding 230 | Tue 6/2/09 | Mon 6/8/09 | 91 |
| 101 | Remove Bldg 231 Slab and SVE System | Tue 6/2/09 | Mon 6/8/09 | 91 |
| 102 | Excavation, Archaeological Montioring, Confirmation Sampling, Analysis and Review | Tue 6/9/09 | Mon 7/13/09 | 101,91 |
| 103 | Excavation Record Survey | Tue 7/14/09 | Tue 7/14/09 | 102 |
| 104 | Utility Reinstallation, Water and Sewer | Tue 7/14/09 | Mon 7/27/09 | 102 |
| 105 | Sewer and Water Line Testing | Tue 7/28/09 | Tue 7/28/09 | 104 |
| 106 | Waterline Disinfection | Wed 7/29/09 | Wed 7/29/09 | 105 |
| 107 | Waste Profile and Analysis | Tue 7/14/09 | Fri 7/31/09 | 102 |
| 108 | Transportation and Disposal | Mon 8/3/09 | Fri 8/14/09 | 107 |
| 109 | Backfill, Compaction and Grading | Thu 7/30/09 | Thu 8/6/09 | 106,103 |
| 110 | AC Placement | Fri 8/7/09 | Fri 8/7/09 | 109 |
| 111 | AC Striping | Mon 8/10/09 | Mon 8/10/09 | 110 |
| 112 | Final Record Survey | Mon 8/10/09 | Mon 8/10/09 | 110 |




Project: Figure 6-1 207-231 Schedule
Date: Mon 10/20/08

Task · Split · Progress · Milestone · Summary · Project Summary · External Tasks · External Milestone · Deadline



| | |
|---|---|
| DRAWN: TJH | PROJECT NO: 4084075106 07 |
| ENGINEER: | SCALE: |
| CHECKED: RR | APPROVED: MLS |
| DATE: 10/2008 | DATE: 10/2008 |

MACTEC

Corrective Action Implementation Work Plan
Presidio Building 207/231 Area
Presidio of San Francisco
San Francisco, California

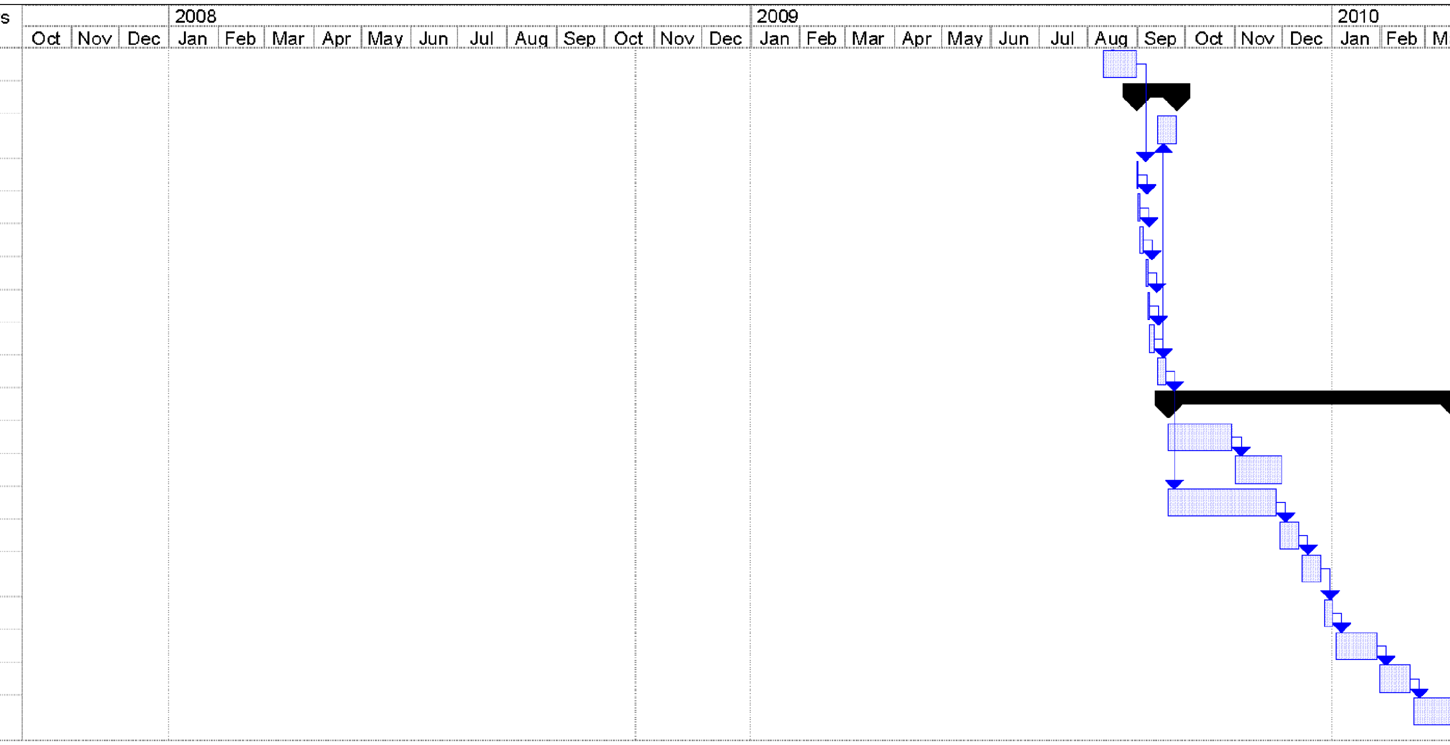
Corrective Action Implementation Schedule

FIGURE 3 of 4
6-1

SchedulePE.mxd - 10/22/08

Figure 6-1
Corrective Action Implementation Schedule

| ID | Task Name | Start | Finish | Predecessors |
|---|---|---|---|---|
| 113 | Installation of Propogule Growing Area Plus Drainage for Are | Tue 8/11/09 | Mon 8/31/09 | 112 |
| 114 | **Post Excavation** | **Tue 9/1/09** | **Fri 9/25/09** | |
| 115 | Post Const. Quarterly GW Monitoring and Reporting - Site Wide | Mon 9/14/09 | Fri 9/25/09 | 121 |
| 116 | GW Monitoring Well Installation Utility Clearance | Tue 9/1/09 | Tue 9/1/09 | 113 |
| 117 | GW Monitoring Well Utility Mark-Out/Review | Wed 9/2/09 | Wed 9/2/09 | 116 |
| 118 | GW Monitoring Well USA Notification | Thu 9/3/09 | Fri 9/4/09 | 117 |
| 119 | GW Monitoring Well USA Mark-Out | Mon 9/7/09 | Mon 9/7/09 | 118 |
| 120 | Install GW Monitoring Wells | Tue 9/8/09 | Tue 9/8/09 | 119 |
| 121 | Survey New GW Monitoring Wells | Wed 9/9/09 | Fri 9/11/09 | 120 |
| 122 | Closeout Contractor Submittal Review | Mon 9/14/09 | Fri 9/18/09 | 121 |
| 123 | **Prepare Record Documents (All RUs)** | **Mon 9/21/09** | **Fri 3/19/10** | **122** |
| 124 | Prepare LUCMRR Addendum All RUs-Draft | Mon 9/21/09 | Fri 10/30/09 | |
| 125 | Prepare LUCMRR Addendum All RUs-Final | Mon 11/2/09 | Mon 11/30/09 | 124 |
| 126 | Construction Completion Report | Mon 9/21/09 | Fri 11/27/09 | 122 |
| 127 | Trust Review Construction Completion Report | Mon 11/30/09 | Fri 12/11/09 | 126 |
| 128 | NPS and Project Group Review of Construction Completion Report | Mon 12/14/09 | Fri 12/25/09 | 127 |
| 129 | Finalize Construction Completion Report | Mon 12/28/09 | Fri 1/1/10 | 128 |
| 130 | RWQCB Review of Construction Completion Report | Mon 1/4/10 | Fri 1/29/10 | 129 |
| 131 | Revise/Finalize Construction Completion Report | Mon 2/1/10 | Fri 2/19/10 | 130 |
| 132 | RWQCB Acceptance of Completion Report/Issues Completion Letter | Mon 2/22/10 | Fri 3/19/10 | 131 |




Project: Figure 6-1 207-231 Schedule
Date: Mon 10/20/08

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Task | | Progress | | Summary | | External Tasks | | Deadline | |
| Split | | Milestone | | Project Summary | | External Milestone | | | |



| | | | |
|---|---|---|---|
| DRAWN: TJH | PROJECT NO: 4084075106 07 | | |
| ENGINEER: | SCALE: | | |
| CHECKED: RR | APPROVED: MLS | | |
| DATE: 10/2008 | DATE: 10/2008 | | |

MACTEC

Corrective Action Implementation Work Plan
Presidio Building 207/231 Area
Presidio of San Francisco
San Francisco, California

Corrective Action Implementation Schedule

FIGURE 4 of 4
**6-1**

SchedulePb4.mxd - 10/22/08

APPENDIX A

STORM WATER POLLUTION PREVENTION PLAN

Reviewed by: RR

# CONTENTS



## FIGURES

# A1.0 INTRODUCTION

On behalf of the Presidio Trust (Trust), MACTEC has prepared this Storm Water Pollution Prevention Plan (SWPPP) for the 207/231 site (Site), located in the Presidio (Figure A-1). MACTEC has prepared this SWPPP in accordance with the provisions of the State Water Resources Control Board National Pollutant Discharge Elimination System (NPDES) General Permit (#99-08 DWQ).

The Trust, in consultation with the NPS, plans to conduct excavation at four soil remedial units (RUs): Building 231 RU, Building 230 RU, Building 38 RU, and Building 271 RU; in situ remediation is proposed for the historic wall interface (northern portion of Building 228 RU and southern portion of Building 231 RU).

This document presents the site background, identification of storm water sources, potential pollutant sources that may affect the quality of storm water discharges during and after construction, erosion and sediment control practices, and storm water monitoring to be deployed at the Site. The provisions of this SWPPP will apply during the construction and for the first year following construction, until MACTEC, on behalf of the Trust, submits a Notice of Termination (NOT). MACTEC will also serve as the Trust's Construction Manager for the Site.

## A1.1 Site Background

The Site comprises approximately eight acres of land located in the northeastern portion of the Presidio of San Francisco, California (Presidio), adjacent to the Crissy Marsh and bisected by the Doyle Drive/Highway 101 overpasses (Figure A-1). Approximately 6 acres of the site is paved (from the southern boundary to the North Doyle Drive overpass) and the remaining 2 acres to the north of North Doyle Drive overpass is unpaved.

The United States Department of the Army (Army) historically used the Site for servicing and fueling vehicles, and contained two service/gas stations. In addition, the Site had garages, a car wash, a dry cleaning facility that used Stoddard solvent (petroleum hydrocarbon distillate), and fuel oil distribution lines. The garages, car wash, underground storage tanks (USTs), and fuel lines have since been removed and the Site currently consists of buildings, paved parking areas, roadways, and some landscaping. Several utilities both in-service and abandoned pass through the Site. A belowground 72-inch storm drain runs through the eastern portion of the Site that drains to Crissy Marsh. The surface drainage is generally to the northeast, with ground surface elevations ranging from 30 feet North American Vertical Datum

(NAVD) 88 datum to 10 feet NAVD88. Storm water drains into several catch basins, located on site, which transfer the collected storm water into the storm drain identified above.

## A1.2 Previous Investigations

The Trust has conducted detailed studies to evaluate the nature and extent of chemical contamination at the Site; these studies are described in the CAP (*MACTEC, 2007*).

### A1.2.1 Previous Soil Sampling Results

The following chemicals of concern (COCs) were detected in soils at concentrations exceeding cleanup levels in the soil RUs at the site:

- Petroleum hydrocarbons – Total Petroleum Hydrocarbons (TPH) as gasoline, diesel, fuel oil;
- Volatile Organic Compounds (VOCs) – benzene, toluene, ethylbenzene, xylenes (BTEX), methyl tertiary butyl ether (MTBE), tetrachloroethene (PCE), trichloroethene (TCE), vinyl chloride (VC), bromobenzene, methylene chloride (MeCl);
- Polynuclear Aromatic Hydrocarbons (PAHs) – anthracene, acenaphthylene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(b+k)fluoranthene, benzo(k)fluoranthene, chrysene, fluoranthene, phenanthrene, pyrene;
- Polychlorinated Biphenyls (PCBs) and Pesticides – Arochlor 1016, 4,4'-DDD; and
- Metals – arsenic, chromium, cobalt, copper, lead, mercury, silver, and zinc.

### A1.2.2 Compliance

The NPDES General Permit requires that the SWPPP identify personnel to oversee the implementation of best management practices (BMPs) to prevent storm water pollution associated with implementing the corrective actions and to modify the SWPPP as necessary over time. MACTEC will provide the site engineering support; Stacy Sabol is MACTEC's Project Manager and Ram Rao, P.E. is the project's PE. The Contractor for the project is still to be identified. On behalf of the Trust, the Contractor will be responsible for implementing the SWPPP and MACTEC will be responsible for site monitoring to confirm compliance with this SWPPP. See Section A.7.0 for contact information.

# A2.0 STORM WATER SOURCE IDENTIFICATION

Approximately 6 acres of the site is paved (from the southern boundary to the North Doyle Drive overpass) and the remaining 2 acres to the north of North Doyle Drive overpass is unpaved. Surface topography slopes toward the northeast, with surface elevations ranging from 35 feet NAVD88 (on the south) to 10 feet NAVD88 (on the north). Surface water drainage is primarily through overland flow toward several catch basins located within the Site; storm water collected by the catch basins are routed into the 72-inch storm drain, which drains into the Crissy Marsh. Current and “During Construction” generalized storm water flow directions are shown on Figures A-1 and A-2, respectively. Generalized flow directions following construction are shown on Figure A-3.

# A.3.0 POTENTIAL SOURCES OF POLLUTION

## A.3.1 Chemicals of Concern in Soils

As discussed in Section A1.1.1, COCs in soil are: TPH as gasoline, diesel, and fuel oil, VOCs, PAHs, PCBs, pesticides, and metals. Excavated soil and waste will be disposed of in accordance with Federal and State regulations. As discussed in the Corrective Action Implementation Work Plan accompanying this SWPPP, excavated soil will be temporarily stockpiled onsite for characterization prior to off-site disposal. Section A.4.2 describes handling of stockpiled soil.

## A.3.2 Storm Water Pollutant Discharges

Sources of storm water pollutants at the Site includes:

- <u>Staging and equipment storage area:</u> The Contractor will mobilize earth-moving equipment such as loaders and excavators to the site during construction activities. Trucks, excavators, and other construction vehicles left overnight will be parked on site. The Contractor will stage haul trucks along Mason Street to the east of Marshall Street. Leaks from equipment or ruptures of equipment liquid reservoirs (fuel, crankcase oil, gearbox oils, hydraulic oils, or radiator coolant) can release potential pollutants.

- <u>Excavation, Backfilling, Utility Relocation, and construction activities</u>: Excavation activities can release soil/sediment to storm water that may or may not be impacted with COCs.

- <u>Stockpile storage area:</u> Soil stockpiles can release soil/sediment to storm water that may be impacted with COCs.

## A.3.3 Non-Storm Water Discharges

No non-storm water discharges are anticipated at the Site under regular operating conditions. However, a contingency plan for discharge under the following upset conditions is presented below:

- Discharge of Stored Groundwater From Water Storage Tanks: Dewatering will only be conducted when the Contractor is on site. In the event of a leak from storage tanks(s), the Contractor's personnel will contain the spill using spill containment kits.

- Secondary Containment of Groundwater Stored in Tanks:  Baker Tanks or equivalent to be used on the project will be placed on secondary containment berms.  These berms will be chemically resistant polyethylene liner material and will have a minimum floor thickness of 60 mil and sidewall thickness of 40 mil (see web site for example product details: www.bakercorp.com/pdfs/BakerCorp_Tanks.pdf).

- Discharge of Sewage from Temporary Aboveground Sanitary Sewer Lines:  The Contractor will inspect twice daily the aboveground sewage lines.  The Contractor will provide a plan for approval by the Stakeholders for recovery of sewage spill during upset conditions; the intent of the plan will be to prevent discharge into the storm drain system and entry into the Crissy Marsh (see Section 01355:  Environmental Protection, Volume II, Technical Specifications).  This plan will also include plan for prevention of discharge to the storm drain system during the installation of utility lines to be installed during the course of this project).  In the event of an accidental spill, the containment of the spill will follow the requirements of the Trust's Sanitary Sewer Management Plan (SSMP) (*Trust, 2007*).  The Trust will be responsible for completing internal and regulatory agency reporting in accordance with the requirements of the SSMP.

- Discharge During Refueling of Construction Equipment:  In the event of accidental spill during refueling, the Contractor will contain the spill using spill containment kits (see Section A.4.5, Management Practices for Construction Vehicle and Equipment).

# A.4.0 EROSION AND SEDIMENT CONTROL PRACTICES

## A.4.1 General Practices

The Contractor will implement BMPs such as engineering controls, scheduled inspections, maintenance, employee training, and other management activities to minimize the potential for pollutants to enter storm water. These practices conform to the recommendations described in the Association of Bay Area Governments (ABAG) publication Manual of Sediment and Erosion Control Measures (*ABAG, 1995*) and the RWQCB's Erosion and Sediment Control Field Manual (*RWQCB, 1999*). Figure A-2, Storm Water Pollution Prevention Plan, Construction Phase, shows planned erosion and sediment control practices; Figure A-3, Storm Water Pollution Prevention Plan, Restored Site, shows sediment control practices after construction completion. The Contractor will ensure that an extra supply of the engineering control materials are available onsite, which can be deployed as necessary in the event of unseasonal and heavy summer rains. In addition, should a significant rain event occur, the Contractor will not conduct active earthwork or soil disturbances and if necessary, will transfer excavation spoils from temporary excavations into main excavations and/or the stockpile staging area at the end of each work day.

The Contractor will review weather forecasts daily on the web site "http://www.sfgate.com/weather/." On week days, if impending bad weather is projected between the end of the work day and the start of the next work day, the Contractor will ensure that no soil remains outside the footprint of the excavation at the end of each work day; the excavation spoils will be transferred into the stockpile staging area or pushed back to within the excavation. At the end of each workweek regardless of the weather forecast, the Contractor will ensure that no uncovered and unlined soil remains unattended outside the footprint of the excavation.

## A.4.2 Onsite Sediment and Erosion Control Practices

***Excavation Areas:*** The Contractor will:

- Use straw bales, straw wattles, silt fences, etc. until the site is repaved in paved areas.
- Use straw bales, straw wattles, silt fences, and ground cover (e.g., landscaping fabric, blown straw) in unpaved areas following excavation and prior to backfilling and following construction until the vegetative ground cover is established.

- Place a silt fence underneath the grate of the catch basins in pedestrian and/or vehicular traffic areas or straw bales around the catch basins in non-traffic areas during excavation activities.

- Adjust the location and type of erosion control materials as necessary to accommodate actual field conditions during construction.

***Soil Staging Areas:*** Figure A-2 shows proposed locations of soil staging facilities. The Contractor will:

- Construct the soil staging facilities with 20-mil plastic liner underneath the stockpile and 10-mil plastic liner as a cover with the sides bermed with sterile weed free straw wattles.

- Cover stockpiled material in the soil staging facilities with weighted 10-mil plastic during periods when material is not being added or removed from the stockpile.

- Set up an onsite decontamination area for equipment washing, to minimize the volume of water used for decontamination and to prevent runoff.

### A.4.3 Offsite Sediment and Erosion Control Practices

For soil excavated at the Site, the Contractor will:

- Load trucks from soil stockpile area (see Figure A-2 for location of stockpile).

- Spray potable water on disturbed areas as necessary to reduce dust.

### A.4.4 Wind Erosion and Dust Control

As needed, the Contractor will spray potable water on the disturbed areas and active stockpiles (i.e., while loading into and out of stockpiles and when the stockpiles are uncovered) for dust control and will cover stockpiles and debris piles with plastic.

### A.4.5 Management Practices for Construction Vehicles and Equipment

The Contractor will conduct activities in conformance with the following guidelines to minimize vehicle/equipment contact with storm water:

- Berm minor spills such as fuel from vehicles or other heavy equipment with soil and clean using dry absorbent materials.

- Cover the spill if it is raining to avoid runoff.
- Properly dispose wastes associated with spill cleanup.

The Contractor will use the following practices during equipment and vehicle maintenance, vehicle fueling, and washing of construction vehicles:

**Equipment and Vehicle Maintenance:** The Contractor will:

- Maintain construction equipment to prevent oil or other fluid leaks.
- Clean vehicles and equipment to prevent excessive buildup of oil and grease.
- Use off-site repair shops.
- Keep spill cleanup materials accessible.
- Inspect on-site vehicles and equipment regularly for leaks and repair problems immediately.
- Check incoming vehicles and equipment (including delivery trucks, and employee and subcontractor vehicles) for leaking oil and fluids; prevent leaking vehicles or equipment from entering the site.
- Segregate and recycle wastes, such as greases, used oil or oil filters, antifreeze, cleaning solutions, automotive batteries, hydraulic and transmission fluids.

**Rumble Pads to Prevent Track Out:** The trucks will be staged on a paved surface along Old Mason Street, either just west of Building 610 or east of Marshall Street. The trucks will access the site (and the stockpile area) along paved surfaces. Therefore, it is not anticipated that the trucks will track significant dirt.

As a contingency, however, rumble pads will be placed at the site exit for trucks to prevent offsite tracking of dirt. No wet washing of tires will be conducted.

**Fueling:** For refueling, the Contractor will:

- Primarily use EPA approved double wall tanks to be located in the contractor equipment storage and refueling area depicted on Figure A-2.

For spill containment, the Contractor will:

- Place spill kits (containing gloves, goggles, absorbent pillows, pads, and socks) near each fuel tank and inside each excavator to contain liquid spills in case of a release. The spill kits will consist of a lever lock top for quick access and a bright yellow label for high visibility.

### A.4.6 Post-Construction Erosion Control

Figure A-3 shows post-construction erosion-control measures that include one or more of the following for the unpaved areas:

- Bionet all-natural fabric (or equivalent);
- Straw wattles made of sterile weed free rice straw; and
- Sterile weed free straw bales, ground cover, etc.

The Trust will adjust the location and type of erosion control materials necessary to accommodate field conditions. The Trust, in consultation with NPS, will assure that erosion control measures are maintained until post construction vegetation has matured and artificial erosion control measures are not required. The Trust or its contractor will monitor post-construction erosion control measures. MACTEC, on behalf of the Trust, will file a NOT under the General Permit after construction has been completed and post-construction erosion control measures have been installed.

# A.5.0 STORM WATER MONITORING PROGRAM

The purpose of this storm water monitoring program is to comply with the General Permit and evaluate the effectiveness and proper implementation of onsite BMPs in limiting the discharge of pollutants to storm water runoff.

## A.5.1 Training

MACTEC as the Trust's Construction Manager will train its field staff and those of the Contractor regarding SWPPP requirements, including inspection, actions necessary to implement BMPs, and reporting. Section A.6.0 includes a form that documents persons who have been trained in the required inspection and reporting requirements.

## A.5.2 Site Inspection Procedures

MACTEC will oversee periodic inspections of the storm water system BMPs (described in Section A.4.0) and potential sources of pollution (described in Section A.3.0) using staff familiar with SWPPP requirements and trained to identify non-compliance activities. MACTEC will review inspection data to determine if any changes are required to maintain compliance with the conditions of the General Permit and will take corrective actions, if required.

During construction, inspections will be conducted weekly, and prior to and after storm events. MACTEC will also conduct storm water monitoring for a year following construction. During the winter months, MACTEC will conduct weekly inspection. For the remainder of the year, MACTEC will conduct monthly inspection. MACTEC will maintain inspection records that include inspection dates, locations, observations, and any measures taken to reduce or prevent storm water pollution.

MACTEC and Contractor field staff will use the presence of significant sediment load in stormwater runoff as an indicator of the presence of potential COCs in runoff during a storm event, as COCs in soil

are primarily present in the adsorbed phase (i.e., attached to sediment particles) rather than the dissolved phase. No storm water sampling is recommended because erosion control measures described in Section A.4.0 should minimize potential for erosion of soils/sediment (and downslope transport of COCs) from the site during excavation activities. The Construction Manager will evaluate the effectiveness of BMPs and make adjustments if significant sediment load is detected in storm water runoff down slope of the installed silt fences.

### A.5.3 Record Keeping and Reporting

#### A.5.3.1 Non Compliance Reporting

MACTEC will report all instances of non compliance with this SWPPP and General Permit to the RWQCB by telephone as soon as the discharge has been observed. MACTEC, on behalf of the Trust, will send a written report within 14 calendar days of violation. Non compliance reports will include:

- Type(s) of non compliance;
- The BMPs currently being implemented;
- Description of actions undertaken and/or necessary to achieve compliance; any additional BMPs, which will be implemented to prevent future non compliance; and
- Estimated implementation schedule for corrective actions.

#### A.5.3.2 Record Keeping

The Trust will:

- Amend this plan as necessary during implementation;
- Maintain storm water inspection forms and training documentation for at least six years in accordance with the General Permit; and
- Document the SWPPP implementation in a letter report to the RWQCB following the completion of construction activities.

# A.6.0 ACKNOWLEDGMENT PAGE

This section includes names and signatures of persons who have been trained in the required inspection and reporting requirements of this plan.

***"I am aware of storm water pollution prevention management practices, and I understand the contents of this SWPPP and the General Permit. I have also been trained in the inspection and reporting procedures outlined in this SWPPP."***

| NAME | SIGNATURE | DATE |
|---|---|---|
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| | | |
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| | | |

# A.7.0 CONTACTS

**In case of emergency, contact the following:**

**MACTEC (Engineer and Construction Manager)**:

Construction Manager: TBD

| | | |
|---|---|---|
| Project Engineer: Ram Rao, P.E. | | Office: (510) 451-1011<br>Fax: (510) 451-3165<br>Cell: (510) 414-9315 |
| Address: | 600 Grand Avenue, Suite 300<br>Oakland, California 94610 | |
| Project Manager: Stacy Sabol | | Office: (415) 278-2107<br>Fax: (415) 777-9706 |
| Address: | 28 Second Street, Suite 700<br>San Francisco, California 94105 | |

**Presidio Trust (Owner)**

| | |
|---|---|
| Remediation Project Manager: Ryan Seelbach | Office: (415) 561-5082<br>Fax: (415) 561-2132 |
| Street Address and UPS/Fed Ex Mailing: | 67 Martinez Street<br>San Francisco, California 94129 |
| USPS Mail: | 34 Graham Street<br>Post Office Box 29052<br>San Francisco, California 94129 |

**National Park Service**

| | |
|---|---|
| Environmental Project Manager: Brian Ullensvang | Office: (415) 561-4726<br>Fax: (415) 561-4727<br>Cell: (510) 710-7034 |
| Street Address: | Fort Mason Building 101<br>San Francisco, California 94123 |
| Mailing Address: | Fort Mason Building 201<br>San Francisco, California 94123 |

**The Contractor (To Be Decided)**

# A.8.0 REFERENCES

Association of Bay Area Governments (ABAG), 1995. *Manual of Sediment and Erosion Control Measures.*

MACTEC Engineering and Consulting, Inc. (MACTEC), 2007a. *Final Corrective Action Plan, Building 207/231 Area, Presidio of San Francisco, California*. October.

_____, 2007b. *Revised Draft Corrective Action Implementation Work Plan, Building 207/231 Area, Presidio of San Francisco, California*. November.

Presidio Trust, 2007. *Sewer System Management Plan*. August

Regional Water Quality Control Board (RWQCB), 1999. *Erosion and Sediment Control Field Manual.*

State Water Resources Control Board (SWRCB), 2004. *State Water Resources Control Board National Pollutant Discharge Elimination System (NPDES) General Permit (# 99-08 DWQ)*. August.

FIGURES


LEGEND

| | | | |
|---|---|---|---|
| HISTORIC WALL | | STORM DRAIN | SD |
| TOPOGRAPHIC CONTOUR | 24 | PERIMETER FENCE | |
| STREET PAVED ASPHALT AREA | | STORM DRAIN MANHOLE | |
| UNPAVED AREA | | STORM DRAIN INLET | |
| LIGHT USE ASPHALT PAVED AREA | | STORMWATER FLOW LINES | |
| EXISITNG BUILDINGS | | | |

N

40 0 40 80

SCALE IN FEET

4084075106032.DWG 1.0
20081016.0936

MACTEC

STORM WATER POLLUTION PREVENTION PLAN
EXISTING CONDITION
PRESIDIO BUILDING 207/231 AREA
PRESIDIO SAN FRANCISCO
SAN FRANCISCO, CALIFORNIA

FIGURE

A-1

| DRAWN | JOB NUMBER | CHECKED | CHECKED DATE | APPROVED | APPROVED DATE |
|---|---|---|---|---|---|
| JHD | 4084075106 | JHD | 10/2008 | RR | 10/2008 |


LEGEND

| | |
|---|---|
| HISTORIC WALL | |
| TOPOGRAPHIC CONTOUR | 24 |
| STREET PAVED ASPHALT AREA | |
| UNPAVED AREA | |
| LIGHT USE ASPHALT PAVED AREA | |
| EXISITNG BUILDINGS | |
| STOCKPILE STAGING AREA | |
| STORMWATER FLOW LINES | |
| FILTER FABRIC SET BENEATH DRAIN INLET IN STREET | |
| STRAW WATTLE AROUND DRAIN INLET SET IN CURB | |
| STRAW WATTLE AROUND DRAIN INLET | |
| STORM DRAIN | SD |
| TEMP. ABOVE GROUND STORM DRAIN | SD |
| PERIMETER FENCE | |
| ASSUMED EXCAVATION AREA | |
| STORM DRAIN TO BE REMOVED | |
| STORM DRAIN MANHOLE | |

40 0 40 80
SCALE IN FEET

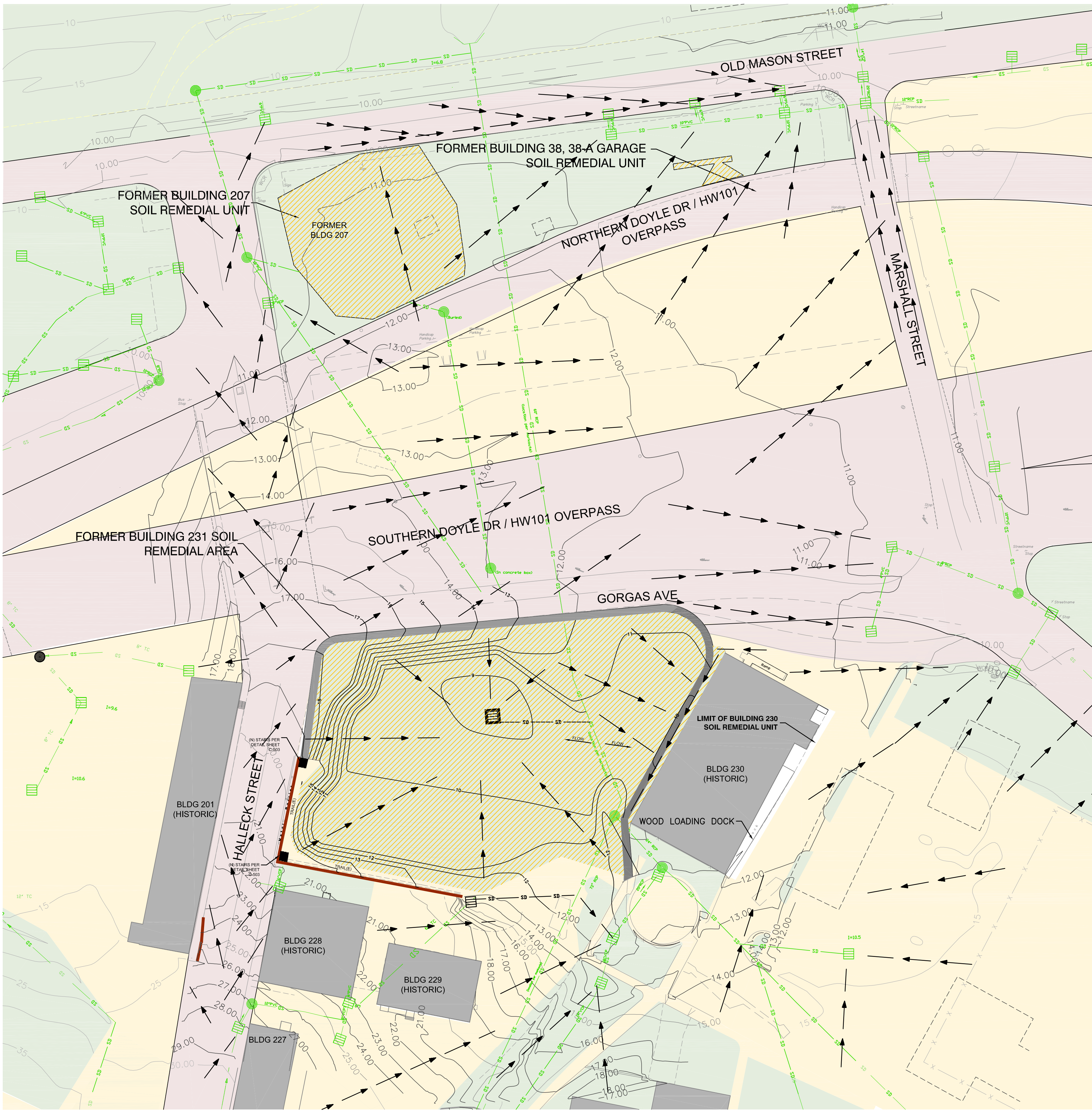
4084075106033.DWG 1.0
20081015.1539

MACTEC

STORM WATER POLLUTION PREVENTION PLAN
CONSTRUCTION PHASE
PRESIDIO BUILDING 207/231 AREA
PRESIDIO SAN FRANCISCO
SAN FRANCISCO, CALIFORNIA

FIGURE
A-2

| DRAWN | JOB NUMBER | CHECKED | CHECKED DATE | APPROVED | APPROVED DATE |
|---|---|---|---|---|---|
| JHD | 4084075106 | JHD | 10/2008 | RR | 10/2008 |




LEGEND

| | |
|---|---|
| HISTORIC WALL | |
| TOPOGRAPHIC CONTOUR | 24 |
| NEW TOPOGRAPHIC CONTOUR | 24 |
| STREET PAVED ASPHALT AREA | |
| UNPAVED AREA | |
| LIGHT USE ASPHALT PAVED AREA | |
| EXISITNG BUILDINGS | |
| NEW AC PATH AT GRADE | |
| NEW RAISED AC PATH | |
| STORMWATER FLOW LINES | |
| STORM DRAIN DI | |
| NEW STORM DRAIN DI | |
| STRAW WATTLE AROUND NEW STORM DRAIN DI | |
| STORM DRAIN | SD |
| NEW BELOW GROUND STORM DRAIN | SD |
| EROSION COLTROL MATERIALS TO BE PLACED AS NEEDED | |
| STORM DRAIN MANHOLE | |

N

40 0 40 80

SCALE IN FEET

4084075106034.DWG 96.0
20081016 0949

MACTEC

STORM WATER POLLUTION PREVENTION PLAN
RESTORED SITE
PRESIDIO BUILDING 207/231 AREA
PRESIDIO SAN FRANCISCO
SAN FRANCISCO, CALIFORNIA

FIGURE
**A-3**

| DRAWN | JOB NUMBER | CHECKED | CHECKED DATE | APPROVED | APPROVED DATE |
|---|---|---|---|---|---|
| JHD | 4084075106 | JHD | 10/2008 | RR | 10/2008 |

APPENDIX B

TRAFFIC CONTROL AND SIGNAGE GUIDE

Reviewed by: RR

# CONTENTS



## FIGURES

# B1.0 TRAFFIC CONTROL AND SIGNAGE GUIDE

## B1.1 Background

The Presidio Trust (Trust) will be removing contaminated soil from four of the five soil remedial units (RUs) at the Building 207/231 Area (Site). Soil RUs where excavation will be performed are the 230 RU, 38 RU, 207 RU, and 231 RU. In situ injection will be conducted at the historic wall interface (northern portion of Building 228 RU and southern portion of Building 231 RU).

At the RUs where excavation is to be conducted, after the materials are removed and transported off-site, the site will be backfilled as illustrated on the Construction Documents and as described in the Work Plan. These activities are anticipated to be conducted during Summer 2008. A goal of this project is to remove the impacted material while minimizing potential construction impacts to local roadways and traffic and Site users.

## B1.2 Project Area

Temporary construction fencing will be placed around the project area, which is bounded by Building 228 to the south, eastern edge of Building 230 RU to the east, Mason Street to the north, and Halleck Street to the west (Figure B-1). Construction equipment routes will be typically limited to within the fenced area. No Presidio street traffic will be allowed within the fenced area.

## B1.3 Information Signs

The Trust will prepare signs explaining the purpose, extent, and approximate schedule of the removal operations and install them adjacent to the site work areas.

## B1.4 Truck Routes

Proposed truck haul routes are shown on Figure B-1 (Truck Haul Routes Plan).

***Truck Entrance Routes:***

- Enter the Presidio through the Gorgas Gate or Richardson Slip Ramp

- Follow Gorgas Avenue or Richardson Avenue respectively to the Site

- Turn right on Marshall Street and proceed to the staging area at the corner of Marshall and Mason
- Enter site through gate on a temporary construction fence along Marshall Street.

***Loaded Truck Exit Routes:***

- Loaded trucks will exit the Site east on Gorgas Avenue
- Turn north on Marshall Street
- Turn east on Mason Street
- Turn south on Marina Boulevard
- Turn west on Doyle Drive to Highway 101.

## B1.4 Traffic Information and Detour Signs

Gorgas Avenue will be closed between Marshall Street and Halleck Street during work at the 231 RU. Signs will be used to direct traffic around the site. Cautionary signs to be placed at and in the vicinity of the Project Area are depicted on Figure B-2 (Transportation Plan).

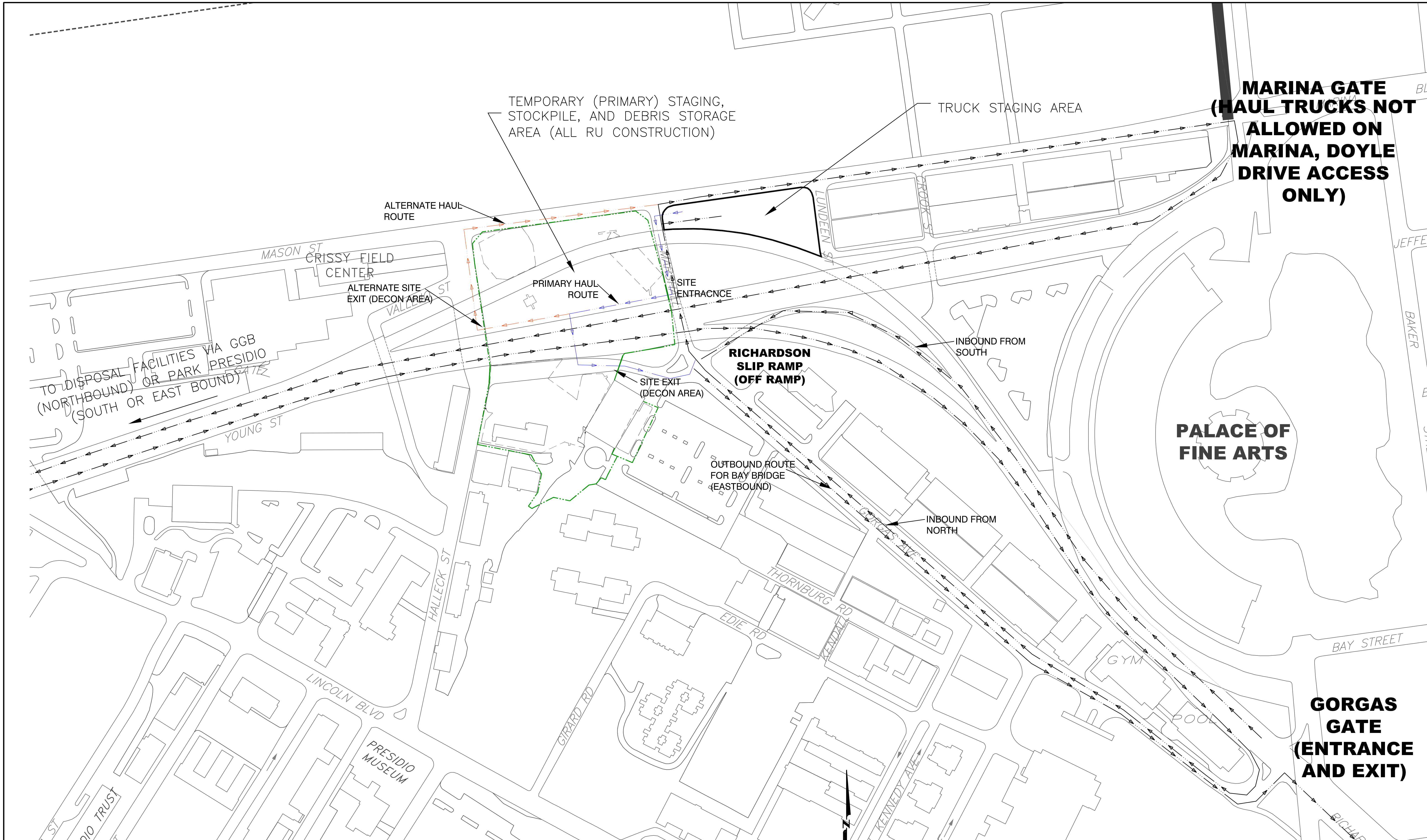
## B1.5 Pedestrian Restrictions

During construction, pedestrians will not be permitted within the fenced area. A flag person will be present at each of the entrances (gates) into the Project Area when trucks need to come in and out of the Project Area. Signs will be placed along Gorgas Avenue, Mason Street, Halleck Street, and Marshall Street directing pedestrians to use caution and watch for trucks in the area.

## B1.6 Post-Construction Signage

The Trust will develop text and sign designs and proposed locations for post-construction signs and fences. Details will be finalized during the construction phase. Signs will be prepared by the Trust sign shop and will be installed by sign shop personnel.

FIGURES




LEGEND

| | |
|---|---|
| PRIMARY TRUCK HAUL ROUTE | |
| ALTERNATIVE TRUCK HAUL ROUTE | |
| ASSUMED EXCAVATION AREAS | |
| PERIMETER FENCE | |

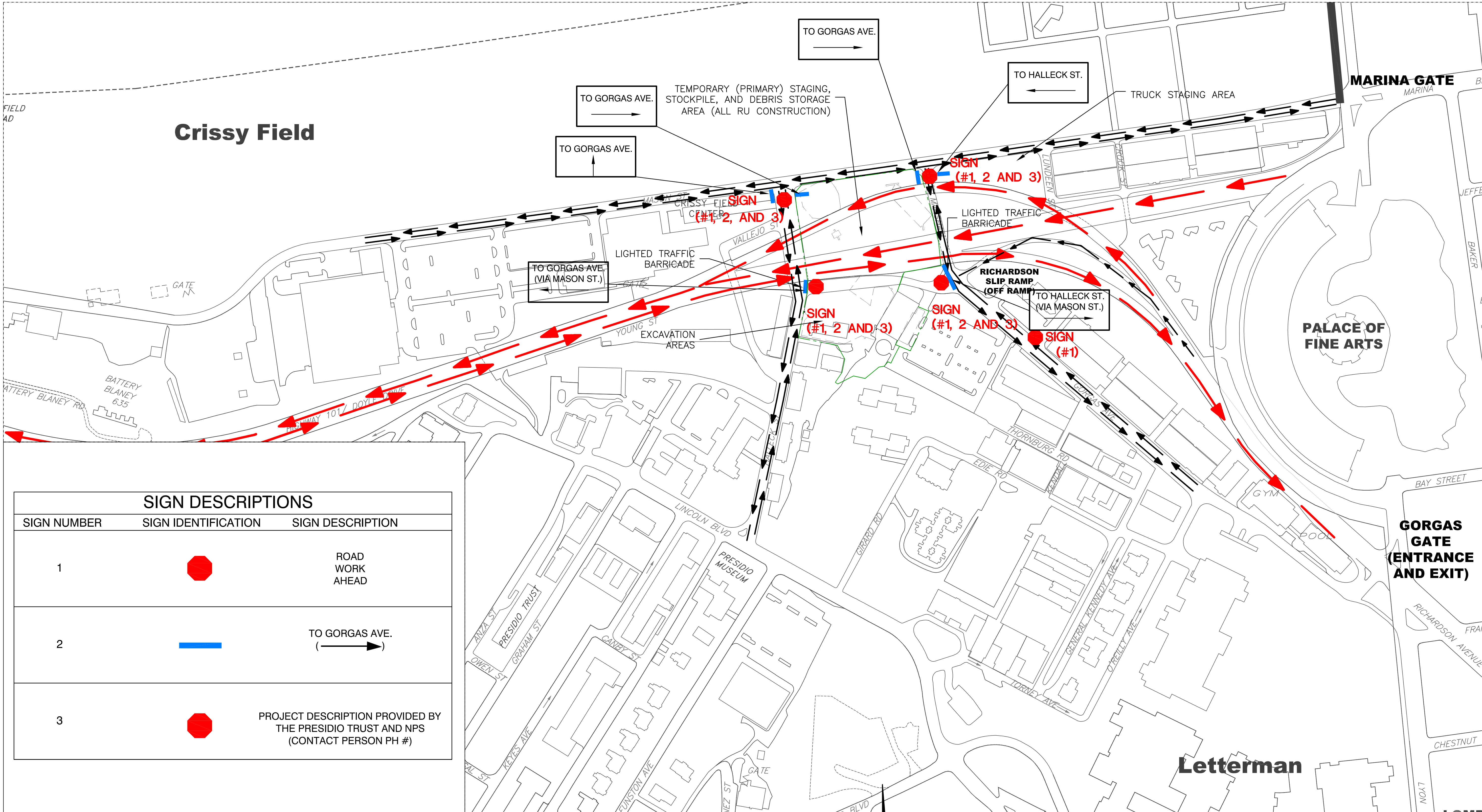
100 0 100 200
SCALE IN FEET

MACTEC

TRUCK HAUL ROUTE PLAN
PRESIDIO BUILDING 207-231 AREA
PRESIDIO SAN FRANCISCO
SAN FRANCISCO, CALIFORNIA

FIGURE
**B-1**

| DRAWN | JOB NUMBER | CHECKED | CHECKED DATE | APPROVED | APPROVED DATE |
|---|---|---|---|---|---|
| JHD | 4084075106 | JHD | 10/2008 | RR | 10/2008 |




## SIGN DESCRIPTIONS

| SIGN NUMBER | SIGN IDENTIFICATION | SIGN DESCRIPTION |
|---|---|---|
| 1 | | ROAD WORK AHEAD |
| 2 | | TO GORGAS AVE. (⟶) |
| 3 | | PROJECT DESCRIPTION PROVIDED BY THE PRESIDIO TRUST AND NPS (CONTACT PERSON PH #) |

LEGEND
DOYLE DRIVE/HWY 101 OVERPASS TRAFFIC
TWO DIRECTIONAL CITY STREET TRAFFIC
ASSUMED EXCAVATION AREAS
PERIMETER FENCE
TRAFFIC SIGN
DETOUR SIGN

N

150 0 150 300
SCALE IN FEET

MACTEC

TRANSPORTATION PLAN
PRESIDIO BUILDING 207-231 AREA
PRESIDIO SAN FRANCISCO
SAN FRANCISCO, CALIFORNIA

B-2

| DRAWN | JOB NUMBER | CHECKED | CHECKED DATE | APPROVED | APPROVED DATE |
|---|---|---|---|---|---|
| JHD | 4084075106 | JHD | 10/2008 | RR | 10/2008 |

4084075106039.DWG 1.0

# APPENDIX C

# DEWATERING PLAN

# CONTENTS



## ATTACHMENTS

# C1.0 DEWATERING PLAN

This Dewatering Plan is an outline of dewatering operations that will be implemented during the Construction Phase of the project. This plan describes the practices to manage the discharge of pollutants when non-storm water (groundwater) and accumulated precipitation (storm water) must be removed from the site so that construction work may be accomplished. Storm water mixed with non-storm water will be managed as non-storm water.

## C1.1 Objectives

The objective of this Dewatering Plan is to appropriately and safely manage the water that is encountered during construction activities at the site. Specifically, the Contractor will:

- dewater excavations only when necessary (i.e., during excavation and/or backfilling) so that work may progress.
- assure that collected water is stored on-site under safe conditions until testing can be completed to allow for disposal of the water.
- assure that all collected water is disposed in accordance with all applicable laws, local permits, project-specific permits, and regulations.

## C1.2 Anticipated Groundwater Extraction Rates and Groundwater Storage Requirements

MACTEC estimates that approximately 1 to 5 gallons per minute (gpm) will be produced during the excavations at all the soil remedial units. Because the Project Area will be fenced off, not allowing access to the excavation areas by pedestrians and vehicular traffic, this plan proposes groundwater extraction only during construction (i.e., excavation, and/or backfilling, etc.). As such, over a construction workday of 12 hours and for groundwater extraction rates of 1 to 5 gpm, approximately 720 gallons to

3,600 gallons of water will be produced during construction each day. Up to two baker tanks, each with a capacity of 21,000 gallons, will be used to store water onsite for the duration of construction, pending collection of wastewater samples and testing to confirm compliance with the Trust's Industrial Wastewater Discharge Permit. The locations of the baker tanks are depicted on Figure 1-2 of the Work Plan.

## C1.3 Dewatering Approach During Construction Phase

The Contractor shall:

- Install a dewatering system to control surface waters and lower and control groundwater table levels and hydrostatic pressures to allow excavation, backfill, and compaction to be performed in compliance with the Work Plan.

- Maintain stability of excavation and surrounding features.

It is anticipated that the Contractor will use thrash pumps to transfer extracted water from the excavation to the baker tank(s). No pumped wells are anticipated. If pumped wells are necessary, then MACTEC will provide the Trust, the NPS, and other stakeholders, a design of the pumped well system in a weekly stakeholder meeting for review and approval prior to implementation.

## C1.4 Discharge and/or Disposal of Extracted Groundwater

For discharge of extracted water, the Contractor shall comply with the Trust's Industrial Waste Water Discharge Permit (Class II Waste water Permit No. 05-0246) issued by the San Francisco Department of Public Works (see attached permit).

MACTEC will sample the extracted water from the tanks once every month for the analytes listed in the Trust's Industrial Waste Water Discharge Permit. Provided the concentrations are below the discharge

limits, the Contractor will discharge the extracted water to the Trust's sanitary sewer system (see Figure 1-2 for manhole to be used for discharge of the extracted water).

However, if the concentrations of any of the analytes exceed discharge limits, then the Contractor will identify off-site disposal facilities to be used for discharge of water. The Contractor will provide MACTEC, the Trust, the NPS, and other stakeholders, a plan for offsite disposal of the water in weekly stakeholder meetings for review and approval prior to arranging for offsite disposal.

ATTACHMENT C1

PRESIDIO TRUST, INDUSTRIAL USER CLASS II WASTEWATER PERMIT

(PERMIT NO. 05-246)

REVIEWED: RR

THE PRESIDIO TRUST

1750 Lincoln Boulevard
San Francisco, California 94129-0052
415/561-5082 fax 561-2132 rseelbach@presidiotrust.gov

**FACSIMILE TRANSMITTAL SHEET**

| | |
|---|---|
| TO: Gary Lieberman | FROM: Ryan Seelbach |
| ORGANIZATION: Mactec | DATE: December 13, 2005 |
| FAX NUMBER: 707.793.3900 | TOTAL NO. OF PAGES INCLUDING COVER: 14 |
| PHONE NUMBER: | |

RE:
Industrial User Class II WW Permit

θ URGENT θ FOR REVIEW θ PLEASE COMMENT θ PLEASE REPLY θ PLEASE RECYCLE

NOTES/COMMENTS:
Gary – Odd pages are coming next.

Thanks, Ryan - 415.561.5082

**Confidential Communication**
This facsimile transmission is intended only for the use of the recipient(s) named above and may contain information that is privileged and confidential. Please forward it directly to the addressee in a sealed confidential envelope. If you are not a named recipient, any dissemination, distribution or copying of information included here is strictly prohibited. If you received this facsimile in error, please notify our office immediately by telephone (collect) and return the original message to the Presidio Trust via the U.S. Postal Service at our expense. Thank you

SAN FRANCISCO PUBLIC UTILITIES COMMISSION
Bureau of Environmental Regulation and Management

3801 THIRD STREET, SUITE 600, SAN FRANCISCO, CA 94124 • Tel. (415) 695-7310 • Fax (415) 695-7388

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CLEAN WATER

GAVIN NEWSOM
MAYOR

E. DENNIS NORMANDY
PRESIDENT

RICHARD SKLAR
VICE PRESIDENT

ANN MOLLER CAEN
ADAM WERBACH
RYAN L. BROOKS

SUSAN LEAL
GENERAL MANAGER

February 7, 2005

SUBJECT: Industrial User Class II Wastewater Permit

Dear Permittee:

Your application for an industrial wastewater discharge permit has been reviewed and processed in accordance with Section 125 of Chapter X (Public Works Code) of Part II of the San Francisco Municipal Code, Article 4.1 (hereinafter referred to as "Article 4.1").

The enclosed Industrial User Class II Wastewater Permit covers all wastewater discharges from your facility into the City and County of San Francisco's (City's) sewerage system. If you wish to appeal or challenge any conditions imposed in this permit, an application for a variance from the strict application of the requirements of Article 4.1 must be filed. However, according to the provisions of Section 128 of Article 4.1, the General Manager may grant variances only when such action is consistent with Article 4.1's general purpose and intent, and the general and specific rules contained in that ordinance.

If you dispose of process wastewater, spent processing solutions, cartridges, filters, residues, sludges or chemicals by offsite hauling, please note the record-keeping requirements specified in Part II-I of the permit.

If you have any questions about the permit requirements, please contact Stephen Todd at (415) 695-7368.

Very truly yours,

Tommy Lee, Division Engineer
Environmental Regulation
and Management

Enclosure

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SUSAN LEAL
GENERAL MANAGER

# PERMIT NO. 05-0246

# INDUSTRIAL USER CLASS II WASTEWATER PERMIT

Discharger: Presidio Water Treatment Plant
1773 Gibson Rd.
Presidio of San Francisco, CA 94129

SIC/ID: 4941/02008

Pursuant to the provisions of Sections 120, 124 and 125 of Chapter X (Public Works Code) of Part II of the San Francisco Municipal Code, Article 4.1 (hereinafter referred to as "Article 4.1"), it is hereby ordered that the above industrial user/permittee is authorized to discharge wastewater, from the indicated business address, into the City and County of San Francisco's (City's) sewerage system, provided that such wastewater discharges are performed through the facility's approved side sewer(s), and are in accordance with the conditions set forth in this **Class II Wastewater Permit**.

Compliance with this permit does not relieve the permittee of its obligation to comply with any or all applicable pretreatment regulations, standards or requirements under local, state and federal laws, including any such regulations, standards, requirements, or laws which may become effective during the term of this permit. Noncompliance with any condition of this permit shall constitute a violation of Article 4.1.

| | |
|---|---|
| Effective date of permit: | February 7, 2005 |
| Re-application date: | November 6, 2009 |
| Expiration date of permit: | February 6, 2010 |

By: [signature]
Steven C. Medbery, Manager
Environmental Regulation
and Management

Date: February 7, 2005

## Part I - WASTEWATER EFFLUENT LIMITATIONS AND PROHIBITIONS

A. During the period of February 7, 2005 to February 6, 2010, the permittee is authorized to discharge all wastewater through the approved side sewer(s) from the facility.

B. During the effective period of this permit, any sample representative of the permittee's **wastewater discharges to the side sewer(s)** shall not at any time exceed the following numerical limitations, which are contained in Section 123 of Article 4.1:

1. Based upon any grab sample[1] of the permittee's wastewater:

| Pollutant parameter | Limit |
|---|---|
| pH | 6.0 min.; 9.5 max. |
| Dissolved Sulfides | 0.5 mg/L |
| Temperature (except where higher temperatures are required by law) | 125°F (52°C) |
| Hydrocarbon Oil and Grease | 100 mg/L |

2. Based upon grab samples of the permittee's wastewater, flow-weighted over a production week[2]:

| Pollutant parameter | Limit |
|---|---|
| Total Recoverable Oil and Grease | 300 mg/L |

C. During the effective period of this permit, any sample representative of the permittee's **wastewater discharges to the side sewer(s)** shall not exceed the following numerical limits, which are contained in the City's Department of Public Works (DPW) Order No. 158170 (1991), which is incorporated by reference in this permit:

1. Based upon 24-hour composite sampling[3]:

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[1] *A "**grab sample**" means an individual sample of wastewater collected over a period of time not exceeding 15 minutes, as defined in federal regulations at 40 CFR Part 403.7(d)(2)(iv)(1990).*

[2] *A "**production week**" means the typical number of days in a calendar week when wastewater is discharged from routine operation and/or cleanup of the permittee's facility.*

| Pollutant parameter | Limit (mg/L) |
|---|---|
| Arsenic (T) | 4.0 |
| Cadmium (T) | 0.5 |
| Chromium (T) | 5.0 |
| Copper (T) | 4.0 |
| Lead (T) | 1.5 |
| Mercury (T) | 0.05 |
| Nickel (T) | 2.0 |
| Silver (T) | 0.6 |
| Zinc (T) | 7.0 |

[Where T = Total]

2. Based upon grab sampling:

| Pollutant parameter | Limit (mg/L) |
|---|---|
| Cyanide (T) | 1.0 |
| Phenols | 23.0 |

/ D. The permittee shall not discharge wastewater containing radioactive materials unless the following conditions are satisfied:

1. The permittee obtains a permit from the General Manager[4] of the San Francisco Public Utilities Commission (SFPUC) for the discharge of radioactive materials;

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[3] *"**24-hour composite sampling**" means sampling which is performed over an approximate 24 hour period extending over two consecutive days. Wastewater discharge may not be continuous during the sampled period. A "**composite sample**" means a sample that is collected over time, formed either by continuous sampling or by mixing discrete samples. The sample may be composited either as a **time-composite sample**, i.e. composed of discrete sample aliquots collected in one container at constant time intervals, providing representative samples irrespective of stream flow, or as a **flow-proportional composite sample**, i.e. collected either as a constant sample volume at time intervals proportional to stream flow, or collected by varying the volume of each aliquot as the flow varies while maintaining a constant time interval between the aliquots.*

[4] *"General Manager" means the General Manager of the San Francisco Public Utilities Commission, or a designated representative of the General Manager.*

2. The permittee is authorized to use radioactive materials by the Nuclear Regulatory Commission[5] or other governmental agency empowered to regulate the use of radioactive materials; and

3. The radioactive material is discharged in strict conformity with all Nuclear Regulatory Commission or other governmental agency requirements.

E. The permittee shall not discharge, deposit, throw, cause, allow or permit to be discharged, deposited or thrown into the City's sewerage system[6], any substance of any kind whatever, including oxygen demanding pollutants, that may or will in any manner cause "interference"[7] or "pass through"[8], obstruct or damage the sewerage system, cause a nuisance, interfere with the proper operation, repair or maintenance of the sewerage system, interfere with the proper operation, repair or maintenance of a reclaimed water production or distribution facility, create difficulty for any workers to repair or maintain any part of the sewerage system, or directly or indirectly cause a violation of the City's federal or state sewage discharge permits or any other requirement applicable to the City. Such substances include, but are not limited to the following:

1. Ashes, cinders, sand, gravel, dirt, bark, leaves, grass cuttings and straw, metals, glass, ceramics and plastics, or any other solid or viscous substance capable of causing obstruction to the flow in sewers, or that will not be carried freely under the flow conditions normally prevailing in the City's sewerage system;

2. Any flammable or explosive substances;

3. Any corrosive substances (particularly discharges with pH lower than 5.0), which will cause structural damage to the City's sewerage system;

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[5] *The "**Nuclear Regulatory Commission**" is an agency of the federal government.*

[6] *The "**sewerage system**" means all public facilities for collecting, transporting, treating, and disposing of stormwater and pollutants in wastewater. The sewerage system includes facilities owned and operated by public entities other than the City, where such facilities direct wastewater into the sewerage system and are subject to the jurisdiction of the City as defined by law, contract or interjurisdictional agreement.*

[7] *"**Interference**" means an inhibition or disruption of the sewerage system, treatment processes or operations, or sludge processes, including the use or disposal of sludge, which causes or threatens to cause a violation of any requirement of the City's permits to operate sewage treatment facilities as defined by state or federal laws and regulations. Violations include, but are not limited to, an increase in the magnitude or duration of a violation and the prohibition of City use or disposal of sludge.*

[8] *"**Pass through**" means a discharge which enters receiving waters through the sewerage system in quantities or concentrations which alone, or in combination with a discharge or discharges from other sources, causes or threatens to cause a violation of the City's NPDES permits, including an increase in the magnitude or duration of a violation.*

4. Garbage, excepting properly ground garbage discharged in accordance with Article 4.1, from dwellings and restaurants or other establishments engaged in the preparation of foods and beverages;

5. Any toxic, hazardous (as defined in the California Code of Regulations at Title 22, or in federal regulations at 40 CFR Part 261), noxious or malodorous substance which either singly or by interaction with other wastes may or will prevent maintenance of the sewerage system or create a nuisance or hazard to the safety of the public or City employees;

6. Any bioaccumulative toxic substance[9] that exceeds the "soluble threshold limit concentration (STLC)"[10];

7. Any wastewater, in temperature or quantity, which will cause the temperature of influent to exceed 104°F (40°C) at the point of introduction to any City wastewater treatment plant; and

8. Any liquids, solids or gases or any discharge that may cause damage or harm to any reclaimed water facility, or that may limit or prevent any use of reclaimed water authorized by Title 22 of the California Code of Regulations.

F. The permittee shall not discharge without a permit any pollutants, except stormwater, directly into a manhole, catch basin, or other opening in the sewerage system other than through an approved side sewer.

G. The permittee shall not increase the use of process water or, in any other way, attempt to dilute a discharge as a partial or complete substitute for adequate treatment to achieve compliance with the requirements of Article 4.1.

H. The permittee shall not discharge groundwater or water from sumps or dewatering facilities into the sewerage system without a permit. An application for a permit pursuant to this paragraph shall be submitted to the General Manager no later than 45 days prior to the proposed commencement of the discharge. Each permit for groundwater discharge shall contain appropriate discharge standards and any other appropriate requirements that must be achieved before discharge into the sewerage system may commence. Such discharges shall be subject to payment of sewer service charges in accordance with the

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[9] *A "**bioaccumulative toxic substance**" means a toxic substance that concentrates in living organisms through direct assimilation or accumulation in the food chain, as defined in Title 22, California Code of Regulations and any amendments thereto.*

[10] *The "**soluble threshold limit concentration** (STLC)" means the concentration of a solubilized and extractable bioaccumulative or persistent toxic substance, which, if equaled or exceeded in a waste, renders the waste hazardous as defined in Title 22, California Code of Regulations and its amendments.*

provisions of applicable City laws. The General Manager may require the permittee to install and maintain meters, at the permittee's expense, to measure the volume of the discharge.

I. The permittee shall not discharge wastewater associated with groundwater cleanup or remediation plans without first obtaining a permit. An application for a permit pursuant to this paragraph shall be submitted to the General Manager no later than 45 days prior to the proposed commencement of the discharge. A permit may be issued only if an effective pretreatment system on the process stream is maintained and operated. Each permit for such discharge shall contain appropriate discharge standards based on Article 4.1 and reports or data provided by the permittee, as well as any other appropriate requirements that must be achieved at the time the discharge commences. Such discharges shall be subject to payment of sewer service charges in accordance with the provisions of applicable City laws. The General Manager may require the permittee to install and maintain meters, at the permittee's expense, to measure the volume of the discharge. The General Manager may require that such permittees shall indemnify and hold harmless the City from any and all costs, claims, damages, fines, remediation costs, losses and other expenses arising from the discharge into the sewerage system.

J. The permittee may discharge wastewater associated with asbestos abatement operations without a permit, provided that the wastewater has been pretreated through a system that provides for removal of waterborne asbestos.

K. In addition to the provisions of Article 4.1, all discharges by the permittee into the City's sewerage system shall comply with all requirements set forth in federal categorical pretreatment standards, applicable state orders and water quality control regulations, sewage discharge permits and orders issued to the City by federal and state agencies, federal and state pretreatment approval conditions, local discharge limitations and regulations promulgated by the General Manager and the City, including any such regulations, limitations, orders, permits, standards, requirements, or laws which may become effective during the term of this permit.

## Part II - MONITORING REQUIREMENTS AND SPECIAL CONDITIONS

A. To determine the permittee's compliance with the limitations of Part I above, all wastewater sampling and measurements, which are representative of the nature and volume of the wastewater discharges, shall be performed at the approved side sewer(s) from the facility. The monitoring point(s) may be designated upstream from where the permittee's wastewater discharges into the City's sewerage system, if access at the discharge location(s) is not feasible, or if the permittee's wastewater merges with the discharge from another facility, before entering the City's sewerage system.

B. The permittee may be required to construct, in accordance with current City standards and at the permittee's expense, a monitoring facility in each side sewer, or in areas further upstream on the permittee's property, for wastewater monitoring purposes.

C. The permittee shall ensure that each designated monitoring point is safe, convenient and accessible to authorized City employees.

D. All compliance sampling and analysis shall be performed in accordance with techniques and procedures approved by the EPA pursuant to section 304(g) of the Clean Water Act and contained in 40 CFR Part 136 and amendments thereto, or otherwise approved by the EPA.

E. The permittee may be required to perform self-monitoring of the wastewater discharges. Such self-monitoring shall be performed at a frequency and for such pollutant parameters as required by the General Manager.

F. The permittee may be required to install and maintain meters to continually measure and record the flow rate of the wastewater discharges.

G. The permittee may be required to perform wastewater treatment on its own site prior to discharge into the sewerage system. Where a wastewater treatment system is employed, the permittee shall ensure that a trained operator is on duty during each operating shift of the facility.

H. The permittee shall store all hazardous materials (e.g. corrosives, flammables etc.) and hazardous wastes within a bermed area or by using some other method of secondary containment, to prevent spills from entering the City's sewerage system.

I. If the permittee disposes of process wastewater, spent processing solutions, cartridges, filters, residues, sludges or chemicals by offsite hauling, the following records shall be kept for periodic review and verification by authorized City inspectors:

1. Receipts and/or purchase records for processing chemicals;

2. Hazardous waste manifests or other documentation for process wastewater, spent processing solutions, cartridges, filters, residues, sludges or chemicals hauled offsite; and

3. A record of the type and quantity of process wastewater, spent processing solutions, cartridges, filters, residues, sludges or chemicals generated at the facility.

## Part III - REPORTING REQUIREMENTS

A. **Within 60 days** of the effective date of this permit, the permittee shall develop and submit (unless previously submitted) to the General Manager:

1. A manual (or self-developed set of instructions) on the proper operation and maintenance of any wastewater treatment system utilized in the facility;

2. A drawing showing a flow diagram and the components of the wastewater treatment system; and

3. Any required information, which has not been submitted in the permittee's wastewater permit application. The permittee will be informed of the deficiency under separate cover.

B. **Within 60 days** of the effective date of this permit, the permittee shall complete and submit (unless previously submitted) to the General Manager a checklist for a Spill Prevention Control and Countermeasures (SPCC) plan, showing facilities and operating procedures to provide protection against spills or accidental discharges of prohibited or regulated materials.

C. **Within 60 days** of the effective date of this permit, the permittee shall complete and submit (unless previously submitted) to the General Manager a checklist for a Hazardous Waste Reduction Assessment[11] (HWRA) of the facility.

Based upon the contents of the checklist submitted, the permittee may subsequently be required to submit a detailed HWRA, including an accounting of the quantities of certain critical chemicals discharged to the sewers, a plan for reducing the amount of critical chemicals discharged, and a report on previous reductions.

D. **Within 60 days** of the effective date of this permit, the permittee shall complete and submit (unless previously submitted) to the General Manager a checklist for a Stormwater Pollution Prevention Plan[12] (SPPP) for the facility.

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[11] *A "**hazardous waste reduction assessment**" means a systematic planned procedure with the objective of identifying ways to reduce or eliminate hazardous waste. Waste reduction describes the reduction, to the extent feasible, of hazardous waste that is generated or subsequently treated, stored or disposed of. It includes any source reduction or recycling activity undertaken by a generator that results in either (1) the reduction of total volume or quantity of hazardous waste or (2) the reduction of toxicity of the hazardous waste, or both.*

[12] *A "**stormwater pollution prevention plan**" has as its major objectives: (a) to help identify the sources of pollution that affect the quality of stormwater discharges associated with industrial activity; and (b) to describe and ensure the implementation of practices to reduce pollutants in stormwater discharges associated with industrial activity.*

E. The permittee shall notify the General Manager, **within 24 hours**, of any violation detected during self-monitoring, of an applicable effluent limitation. Upon the detection of any such violation, the permittee shall re-sample and submit both sets of analytical results within 30 days of the initial detection.

F. Where the permittee conducts self-monitoring or is given split wastewater samples by the City, copies of the analytical results shall be submitted to the General Manager **within 30 days** of the completion of the sampling episode.

G. The permittee shall notify the General Manager at least **30 days prior** to the introduction of new wastewater discharges or pollutants, or any substantial change in volume (i.e. 25 percent or greater variance from the monthly average flow) or characteristics of the wastewater being introduced into the sewerage system, from its industrial activities. The permittee shall certify that the change will not result in noncompliance with the requirements of Part I above. The General Manager may require the issuance of an amended permit before the commencement of such altered discharge, or, in the case of termination of operations, details regarding closure operations.

H. The permittee shall notify the General Manager at least **30 days prior** to the termination of operations. The notification shall include a facility closure and maintenance report, which describes the procedures to be implemented (e.g. disposal of processing baths) to prevent discharges in noncompliance with the requirements of Part I above.

I. All reports (**which must include the certification statement contained in Part IV-N**) and correspondence to the General Manager shall be submitted to the following address:

**Mr. Steven C. Medbery, Manager**
**SFPUC-BERM**
**Bayview Plaza**
**3801 - 3rd Street, Suite 600**
**San Francisco, CA 94124**

## Part IV - STANDARD CONDITIONS

A. Duty to Comply

The permittee must comply with all conditions of this permit. Failure to comply with the requirements of this permit may be grounds for administrative action, including suspension or revocation of this permit, or enforcement proceedings, including civil or criminal penalties, injunctive relief, and severing of the side sewer connection(s).

B. Duty to Re-apply

The permittee must request a renewal or extension of this permit by submittal of a new or revised application at least 90 days before the expiration date of this permit. The General Manager will notify the permittee about the re-application requirement; however, it is the permittee's obligation to re-apply in a timely manner.
An expired permit will continue to be effective and enforceable until the permit is re-issued if:

1. The permittee has satisfied the re-application requirements; and

2. The failure to re-issue the permit in a timely manner is not due to any act, or failure to act, on the part of the permittee.

C. Duty to Mitigate

The permittee shall take all reasonable steps to minimize or correct any adverse impact on the sewerage system or the environment, resulting from noncompliance with this permit, including such accelerated or additional monitoring as necessary to determine the nature and impact of the noncomplying discharge.

D. Duty to Halt or Reduce Activity

In the event of reduction of efficiency of operation, or loss or failure of all or part of the treatment facility, the permittee shall, to the extent necessary to maintain compliance with its permit, control its production or discharges (or both) until operation of the treatment facility is restored or an alternative method of treatment is provided. This requirement applies, for example, when the primary source of power to the treatment facility fails or is reduced. It shall not be a defense for the permittee, to claim that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit.

E. Operation and Maintenance of Pollution Controls

The permittee shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the permittee to achieve compliance with the conditions of this permit. Proper operation and maintenance includes, but is not limited to: effective performance, adequate funding, adequate operator training and staffing, adequate back-up or auxiliary equipment, and adequate laboratory and process controls, including appropriate quality assurance procedures. The permittee shall maintain a record of such servicing for inspection by authorized City inspectors.

F. Bypass of Treatment Facilities

1. Bypass[13] is prohibited unless it is unavoidable to prevent loss of life, personal injury, or severe property damage, and no feasible alternatives (such as the use of auxiliary treatment facilities, retention of untreated wastes, or maintenance during normal periods of equipment downtime) exist.

2. The permittee may allow bypass to occur provided it does not cause effluent limitations to be exceeded, but only if it is for essential maintenance, to ensure efficient facility operations.

3. Notification of bypass:

   a. Anticipated bypass. If the permittee knows in advance of the need for a bypass, it shall submit prior written notice, at least 10 days before the date of the bypass, to the General Manager.

   b. Unanticipated bypass. The permittee shall notify the General Manager within 24 hours of becoming aware of the bypass. This 24-hour notice must be followed within 5 days by a written description of the bypass, its cause, its duration (or, if it has not been corrected, how long it is expected to continue), and what has been done to rectify the problem.

G. Operating Upsets

Any upset[14] experienced by the permittee shall be reported to the General Manager within 24 hours of becoming aware of the upset. A formal written report shall be submitted to the General Manager within 5 days. The report shall include:

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[13] *A "bypass", as defined in 40 CFR Part 403.17, means the intentional diversion of wastestreams from any portion of the permittee's treatment facility.*

[14] *An "upset", as defined in 40 CFR Part 403.16 (a), means an exceptional incident in which there is unintentional and temporary noncompliance with categorical pretreatment standards because of factors beyond the reasonable control*

1. A description of the industrial discharge and cause of noncompliance;

2. The period of noncompliance, including exact date(s) and time(s), or if not corrected, the anticipated time the noncompliance is expected to continue; and

3. Steps being taken and/or planned to reduce, eliminate and prevent recurrence of the noncompliance.

If the permittee fails to report the upset within 5 days, the permittee shall have waived the right to future claim that the noncompliance was due to an upset. If the permittee wishes to establish the affirmative defense of upset to any enforcement action brought for noncompliance, the permittee shall demonstrate, through properly signed contemporaneous operating logs or other relevant evidence that:

a. An upset occurred and the permittee can identify the cause(s) of the upset; and

b. The facility was at the time being operated in a prudent and workman-like manner, and in compliance with applicable operation and maintenance procedures.

H. Slug Loading

The permittee shall verbally notify the General Manager immediately upon the occurrence of an accidental discharge or threatened discharge of a "slug loading"[15] to the sewerage system, resulting from a spill or upset on the permittee's premises. A formal written report, addressing circumstances and remedies shall be submitted to the General Manager within 5 working days of the occurrence. The report shall specify:

1. A description of the nature and cause of the accidental discharge, spill, upset or slug loading. The description should also include location, type, concentration and volume of the discharge;

2. The duration of the discharge, including exact date(s) and time(s), and, if the discharge is continuing, the time by which cessation of the discharge is reasonably expected to occur; and

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*of the permittee. An upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventive maintenance, or careless or improper operation.*

[15] *A "slug loading" means any pollutant (including oxygen demanding pollutants) released in a discharge at a flow rate and/or concentration which will cause a violation of the specific prohibitions listed in 40 CFR Part 403.5(b). (See Part I)*

3. All steps taken to reduce, eliminate, and/or prevent recurrence of such a discharge, spill, upset or slug loading.

Such notification and report shall not relieve the permittee of liability for any expenses, including but not limited to, costs for countermeasures, loss or damage to the sewerage system, liability for fines imposed upon the City because of such occurrences, liability for fines or damages because of such occurrences, or for any damages incurred by a third party.

I. <u>Proper Disposal of Sludges, Spent Chemicals etc.</u>

The disposal of sludges, spent chemicals and hazardous wastes generated by the permittee shall be done in accordance with Section 405 of the Clean Water Act, Subtitles C and D of the Resource Conservation and Recovery Act, and Title 22 of the California Code of Regulations.

J. <u>Hazardous Materials/Waste Storage</u>

The permittee shall store all hazardous materials and hazardous waste within a diked or bermed area, or by using some other method of secondary containment, to prevent spills from entering the sewerage system.

K. <u>Hazardous Waste Discharge</u>

The permittee shall notify the General Manager, the United States Environmental Protection Agency (EPA) Regional Waste Management Division Director, and the California State hazardous waste authorities, in writing, of any discharge into the City's sewerage system of a substance, which, if otherwise disposed of, would be a hazardous waste under federal regulation at 40 CFR Part 261. (See Appendix A, "Hazardous Waste Discharge Response Addresses & Telephone Numbers".)

In the case of any notification made under this paragraph, the permittee shall certify that it has a hazardous waste management/waste minimization program in place, for reducing the volume and toxicity of hazardous wastes generated, to the degree that the permittee has determined to be economically practical.
When the permittee generates a hazardous waste discharge as cited above, it shall report the following:

1. The name of the hazardous waste as set forth in 40 CFR Part 261;
2. The EPA hazardous waste number; and
3. The type of discharge (continuous, batch or other).

If the permittee discharges more than 100 kilograms of such waste per calendar month into the City's sewerage system, the notification shall also contain the following information, to the extent such information is known and readily available to the permittee:

4. An identification of the hazardous constituents contained in the wastes;

5. An estimation of the mass and concentration of such constituents in the waste streams discharged during that calendar month; and

6. An estimation of the masses and concentrations of such constituents expected to be discharged in the wastewater during the following 12 months.

Notwithstanding any other requirement of this Part, the permittee shall provide the notification no later than 15 days after the discharge of the listed or characteristic hazardous waste. **These notification requirements do not apply to pollutants already reported in other self-monitoring reports required in Part III.**

L. <u>Right to Enter Premises</u>

Upon the presentation of proper credentials, employees authorized by the General Manager, when necessary for the performance of their duties, shall have the right to enter the permittee's premises. Such authorized personnel shall, at all reasonable hours, be allowed access to any facilities and records necessary for determining compliance, including, but not limited to the ability to:

1. Copy any records, inspect any monitoring equipment, and sample and monitor any wastewater subject to regulation under Article 4.1; and

2. Inspect the permittee's process areas, chemical and waste storage areas and process activities.

Reasonable hours, in the context of inspection and sampling, include any time the permittee is engaged in any activity, which results in wastewater discharge into the City's sewerage system. Notwithstanding any provisions of law, authorized personnel shall be allowed entry to the permittee's premises **at any time**, if the General Manager determines that an imminent hazard to persons or property exists on, or as a result of activities conducted on, the permittee's premises.

M. <u>Duty to Provide Information</u>

The permittee shall submit to the General Manager, within 15 working days, any information which the General Manager may request to determine whether cause exists for modifying, revoking and re-issuing, or terminating this permit; or to determine compliance with this permit.

N. Signatory Requirements

All applications, reports, or information submitted to the General Manager by the permittee **must** contain the following certification statement and **must** be signed by an authorized representative as described below:

> **"I certify under penalty of law, that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."**

1. By a responsible corporate officer, if the permittee submitting the reports is a corporation. For the purpose of this paragraph, a responsible corporate officer means:

   a. A president, secretary, treasurer, or vice-president of the corporation in charge of a principal business function, or any other person who performs similar policy- or decision-making functions for the corporation; or

   b. The manager of one or more manufacturing, production, or operation facilities employing more than 250 persons or having gross annual sales or expenditures exceeding $25 million (in second-quarter 1980 dollars), if authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures.

2. By a general partner or proprietor if the permittee submitting the reports is a partnership or sole proprietorship respectively.

3. By a duly authorized representative of the individual designated in paragraph 1. or 2. of this section if:

   a. The authorization is made in writing by the individual described in paragraph 1. or 2.;

   b. The authorization specifies either an individual or a position having responsibility for the overall operation of the facility from which the industrial discharge originates, such as the position of plant manager, operator of a well, or well field superintendent, or a position of equivalent

responsibility, or having overall responsibility for environmental matters for the company; and

c. The written authorization is submitted to the General Manager.

4. If an authorization under paragraph 3. of this section is no longer accurate because a different individual or position has responsibility for the overall operation of the facility, or overall responsibility for environmental matters for the company, a new authorization satisfying the requirements of paragraph 3. of this section must be submitted to the General Manager prior to or together with any reports to be signed by an authorized representative.

O. Confidentiality of Information

1. Any records, reports, or information submitted by the permittee to the General Manager, whether made in writing or by communication incorporated in SFPUC reports, shall be available to the public, except upon a showing made by the permittee, satisfactory to the General Manager, that public disclosure of records, reports or information which the General Manager or other authorized personnel has received would divulge methods or processes entitled to protection as confidential trade secrets. All such records, reports, or information at any time may be disclosed to other authorized city personnel or any local, state or federal agency.

2. Whenever the General Manager makes a written request or orders that the permittee furnish information, the request or order shall include a notice that states that:

a. The permittee may assert a business confidentiality claim covering specified information; and

b. If no such claim accompanies the information when the General Manager receives it, it may be made available to the public without further notice to the permittee.

3. In assessing the validity of a business confidentiality claim, the General Manager shall determine whether the information is entitled by statute or judicial order to confidential treatment. In the absence of such a finding, the General Manager shall make the information available for public disclosure.

4. Notwithstanding any other provisions of the above, the permittee's wastewater data is not confidential and shall be made available to the public without restriction.

P. Retention of Records

Copies of any reports that must be submitted to the General Manager by the permittee pursuant to Part III above, shall be retained by the permittee for a minimum of 5 years and shall be made available for inspection and copying by the General Manager or any state or federal agency. This period of retention shall be extended during the course of any unresolved litigation regarding the discharge of pollutants by the permittee or the operation of the City's pretreatment program, or when requested by any state or federal agency.

Q. Charges for Sewerage System Impairment

The permittee shall reimburse the City for extraordinary costs, in addition to the applicable sewer service charge, for treatment, pumping, maintenance of the sewerage system, administration, incidental expenses, inspection and monitoring, and payment of penalties imposed on the City by enforcement agencies, caused by the specific characteristics of any discharge from the permittee's premises into the sewerage system. If the discharge of an industrial waste from the permittee's premises causes an obstruction, damage or other impairment to the sewerage system, the permittee shall pay to the City an amount equal to the costs, penalties and other incidental fees and expenses.

R. Permit Termination

This permit may be terminated, revoked or suspended for reasons including, but not limited to:

1. Falsifying self-monitoring reports;
2. Tampering with monitoring equipment;
3. Refusing to allow timely access to the permittee's facility premises and records;
4. Failure to meet effluent limitations, or the requirements of Article 4.1 and all applicable City, state and federal laws;
5. A discharge or a threatened discharge that may present a hazard to the public health, safety, welfare, natural environment, or sewerage system;
6. Failure to pay fines;
7. Failure to pay sewer service charges; and
8. Failure to meet compliance schedules.

8. Revision of or a grant of variance from such categorical standards pursuant to 40 CFR Part 403.13 of the General Pretreatment Regulations;

9. Typographical or other errors in the permit;

10. Transfer of ownership and/or operation of the permittee's facility to a new owner/operator; and

11. Upon request of the permittee, provided such request does not create a violation of any applicable requirements, standards, laws, or rules and regulations.

The filing of a request by the permittee for a permit modification or re-opening, or termination, or a notification of planned changes or anticipated noncompliance, does not stay any permit condition.

U. Property Rights

The issuance of this permit does not convey any property rights in either real or personal property, or any exclusive privileges, nor does it authorize any injury to private property or any invasion of personal rights, nor any infringement of federal, state or local regulations.

V. Severability

The provisions of this permit are severable, and if any provision of this permit, or the application of any provision of this permit to any circumstance, is for any reason held to be unconstitutional or invalid or ineffective by any court of competent jurisdiction, such decision shall not affect the validity or effectiveness of the remaining portions of this permit.

W. Penalties

1. Criminal Penalties. Under Section 133(a) of Article 4.1, any person who violates any provision of Article 4.1 is guilty of a misdemeanor and upon conviction shall be fined in an amount not exceeding $1,000 or be imprisoned in County Jail for not more than six months, or both. Each day each violation is committed or permitted to continue shall constitute a separate offense.

   Any person who knowingly makes any false statement or misrepresentation in any record, report plan, or other document filed with the General Manager, or tampers with or knowingly renders inaccurate any monitoring device or sampling and analysis method required under Article 4.1, shall be punished by a fine of not

S. Limitation on Permit Transfer

Re-assignment or transfer to a new owner/operator may be approved by the General Manager, provided that:

1. The original permittee gives at least 30 days advance notice to the General Manager, specifying the exact date of change of ownership/operation; and

2. The new owner/operator submits a written certification that:

   a. States that no immediate change of the facility's operations and processes is proposed;

   b. Confirms the exact date on which the transfer is to occur; and

   c. Acknowledges full responsibility for complying with the existing permit.

T. Permit Modification or Re-opening

The terms and conditions of this permit may be subject to modification or re-opening by the General Manager for good causes including, but not limited to, the following:

1. Any new limitations or requirements identified in revisions or amendments to Article 4.1;

2. Additional conditions resulting from any new or revised federal or state pretreatment standards or requirements;

3. Any material or substantial alterations or additions to the permittee's operation processes, or discharge volume or character which were not considered in drafting the effective permit;

4. A change in any condition in either the permittee or the sewerage system, which requires either a temporary or permanent reduction or elimination of the authorized discharge;

5. Information indicating that the permitted discharge poses a threat to the City's sewerage system, or personnel, or the receiving waters;

6. Violations by the permittee of any terms or conditions of the permit;

7. Misrepresentation or failure to disclose fully all relevant facts in the permit application or in any required reporting;

more than $25,000 or by imprisonment in County Jail for not more than six months, or both.

2. Civil Penalties. Under Section 133(b) of Article 4.1, any person who, without regard to intent or negligence, causes or permits any discharge of wastewater or hazardous waste, as defined in Title 22, California Code of Regulations and its amendments, into the City's sewerage system, except in accordance with all permit requirements and other provisions of Article 4.1; violates any provision of a cease and desist order or cleanup and abatement order issued by the General Manager; or violates any requirement or prohibition of Article 4.1; shall be liable civilly to the City in an amount not to exceed $10,000 per day for each violation that occurs.

For intentional or negligent violations, the person so deemed shall be liable civilly to the City in an amount not to exceed $25,000 per day for each violation that occurs.

3. Administrative Civil Penalties. Under Section 133(c) of Article 4.1, notwithstanding Section 133(b), any person who, without regard to intent or negligence, causes or permits any discharge of wastewater or hazardous waste, as defined in Title 22, California Code of Regulations and its amendments, into the City's sewerage system, except in accordance with all permit requirements and other provisions of Article 4.1; violates any provision of a cease and desist order or cleanup and abatement order issued by the General Manager; or violates any requirement or prohibition of Article 4.1, shall be liable civilly to the City in an amount not to exceed $1,000 per day for each violation that occurs.

Notwithstanding Section 133(b), for intentional or negligent violations, the person so deemed shall be liable civilly to the City in an amount not to exceed $2,000 per day for each violation that occurs.

## APPENDIX A

Hazardous Waste Discharge Response Addresses & Telephone Numbers

# PROTOCOLS FOR CONTAMINATED ARCHAEOLOGICAL ARTIFACTS ON PRESIDIO PARK LANDS

Prepared for

MACTEC Engineering and Consulting, Inc.
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Petaluma, CA 94954

and

The Presidio Trust
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3 October 2005

Checked MS

Approved

## CONTENTS

# PROTOCOLS FOR CONTAMINATED ARCHAEOLOGICAL ARTIFACTS ON PRESIDIO PARK LANDS

## 1.0 PURPOSE

This document provides guidance to archaeologists on Presidio park lands who may encounter artifacts contaminated with metals (e.g., lead) and organic contaminants (e.g., TPH, PCBs, and PAHs). Its purpose is to assist archaeologists in the safe handling, processing, and curation of these remains.

These protocols must be used in concert with professionally prepared health and safety plans (HASPs) for both field and lab work. It is essential that field archaeologists read and comply with the HASP for their work site.

These protocols, together with the HASP, will help the archaeologist:

- assess which artifacts should be collected and which recorded then discarded in the field
- safely handle and package artifacts to be returned to the lab
- safely process and store artifacts.

## 2.0 ARTIFACT COLLECTION AND RETENTION POLICIES

The protocols for ITC's archaeological program (ITC 1996) contain guidance for archaeologists monitoring earth-moving in the Presidio and the treatment of artifacts that result from these activities. This document requires collecting a representative "sample" of monitoring finds and retaining all materials from archaeological contexts that are deemed eligible to the National Register of Historic Places. The procedures include the following statements:

- When a discovery is made in the course of monitoring an excavation and the discovery consists of individual artifacts or artifact scatters that lack a meaningful context… the cultural materials collected in such a situation will be packaged together in an archival-quality reclosable plastic bag and labeled under this general provenience.
- Materials not intended for permanent curation… (i.e., pieces of modern trash) will be quantified, briefly described, then discarded.
- Cultural materials that are found to be contaminated that are non-porous will be decontaminated to the levels considered safe [for handling and storage].
- Cultural materials found to be contaminated but which cannot be decontaminated to levels considered safe due to their porosity, will be packaged and labeled with appropriate warnings. (ITC 1996:9.3)

## 2.1 Deciding to Retain or Discard Artifacts

ITC's protocols assume that all potentially important materials can and should be retained. As a practical matter, the expense and hazards associated with curating a large number of contaminated artifacts or a single highly contaminated object may be disproportional to the items' long research or interpretive value as defined in the project research design. While some items may retain a level of residual contamination that would justify their discard once adequately documented in the lab, others can be simply recorded in the field. This decision is at the discretion of the appropriate Presidio park archaeologist.

When artifacts are discovered, the archaeologist (and, where appropriate, the archaeological collections specialist) shall

- apply the decision tree (Figure 1), which specifies the conditions under which archaeological artifacts will be retained by field personnel and passed on to the archaeological laboratory for treatment;
- handle, package, and store artifacts according to the procedures outlined in this document.

# 3.0 ARTIFACT HANDLING, PROCESSING, AND CURATION PROCEDURES

This section guides archaeological personnel in their handling of artifacts at each phase of work: discovery, processing, and storage/curation.

## 3.1 Artifact Material Types

Figure 2 lists the types of materials that can be anticipated on Presidio archaeological sites. Artifacts made of these substances may have come into contact with hazardous materials and become contaminated. The extent of this contamination depends, among other factors, on the porosity of the material of which the artifacts are made. These material types vary greatly in their relative porosity. While the contamination of a non-porous artifact may be limited to the object's surface and removed with relative ease, a porous artifact may retain residual contamination within its interstices. Consequently, the safe handling and treatment of contaminated objects is, in many cases, contingent on their porosity as well as on the contaminant type (i.e., metals contamination is less likely to result in residual contamination post-cleaning as compared to organic contamination).

## 3.2 Handling Artifacts during Fieldwork, Processing, and Curation

Figure 3 describes the manner in which materials of various porosities are to be handled in the field and lab during processing and curation. While these procedures are intended to minimize harm to workers, the artifacts themselves may suffer if the procedures are not thoughtfully applied. In most cases, standard professional archaeological and conservation practices can be applied. The following guidance addresses special problems that may arise from the particular requirements of the HASP or the handling procedures presented in this document.

### 3.2.1 Decontamination in the field

Contaminated artifacts must be decontaminated before they are forwarded to the lab. An exception may be made for material of intrinsic value whose treatment requires procedures that can only be carried out in the lab. In this case, the materials must be packaged appropriately and clearly labeled with the type of suspected contaminant. All artifacts suspected of being contaminated must be packaged to confine the contaminant before they enter the lab.

### 3.2.2 Removing surface dirt

As sediments may contain contaminants, it is important to remove excess surface dirt from artifacts in the field by

- brushing or scraping, as appropriate
- washing with plain water
- cleaning with a solution of Alconox or similar mild detergent, as appropriate

Cleaning with a detergent will, in many cases, decontaminate non-porous and some semi-porous artifacts and allow them to be handled using standard archaeological methods. It is important not to soak porous or semi-porous material or to remove surface treatments (such as decals) during washing or cleaning.

Plain water used to free artifacts of surface dirt may be reused by allowing sediments to accumulate in a series of settling tanks and recirculating the water by a pump. This process of extracting artifacts from their encasing matrix may create or release byproducts that may themselves contain contaminants. These byproducts include

- contaminated water used to clean artifacts
- sediments that accumulate in the settling tanks
- ferrous metal encrustations

These byproducts must be handled, stored, and disposed of according to the HASP and Presidio waste storage policies.

### 3.2.3 Devitrification

Glass hydrates as it is exposed to the air and eventually may devitrify, becoming crazed and flaky. The scale that is created in this process may be harmful and can enter the skin through contact. Glass that shows signs of devitrification—such as iridescence—should be handled with disposable gloves.

### 3.2.4 Water-saturated materials

Porous and semi-porous materials from waterlogged environments should not be dried in the field. Excess liquids that may contain contaminants should not be collected and must be handled in accordance with HASP procedures. However, the artifact's current humidity level should be maintained while it is transported to the lab. In the case of fresh water saturation, this may be achieved by adding de-ionized water.

### 3.2.5 Discarding artifacts in the field

In some cases, a field decision may be made to discard certain artifacts rather than decontaminating and returning them to the lab. In this case, the materials may be simply recorded appropriately and placed back into the excavation.

### 3.2.6 Lab processing

In most cases, artifacts will have been decontaminated in the field before entering the lab. If contaminated materials must be brought into the lab they must be separated from the remainder of the collection. The type of suspected contaminant must be clearly marked on the outside of the box or other container. These artifacts must be handled in accord with the HASP.

When it is necessary to clean and decontaminate artifacts in the lab, arrangements must be made to dispose of any contaminated byproducts before they are created. These byproducts must be handled, stored, and disposed of according to the HASP and Presidio waste storage and disposal policies. When the decision is made in the lab to discard contaminated artifacts, these items must also be disposed of according to Presidio waste storage and disposal policies.

Contaminated artifacts may only be submitted for curation in exceptional circumstances and with the permission of the Presidio archaeologist. In this case, the artifacts must be packaged to confine the contaminant and the type of contamination must be clearly marked on the outside of the box or container.

### 3.2.7 Curation

Federal curation standards at 36CFR79 require that archaeological remains be handled, stored, cleaned, and conserved in a manner that protects them from breakage and possible deterioration from adverse temperature and relative humidity, visible light, ultraviolet radiation, dust, soot, gases, mold, fungus, insects, rodents and general neglect, as well as preserving data that may be studied in future laboratory analyses.

In most cases, contaminated artifacts will have been treated in the field or lab. Thus, handling these materials after curation should not require special measures in addition to standard archaeological curation practices. Any contaminated artifacts must be handled in accord with the HASP.

## REFERENCES

36 Code of Federal Regulations Part 79

*Curation of Federally Owned and Administered Archaeological Collections* (Authority: 16 US Code 470 et seq.)

International Technology Corporation (ITC)

1996 Archaeological Protocols, IT Archaeological Program, Presidio of San Francisco, San Francisco, California. IT Corporation, Martinez, CA, prepared for USA Corps of Engineers, Sacramento. CA.

**Figure 1. Decision Procedures for the Collection of Archaeological Artifacts**

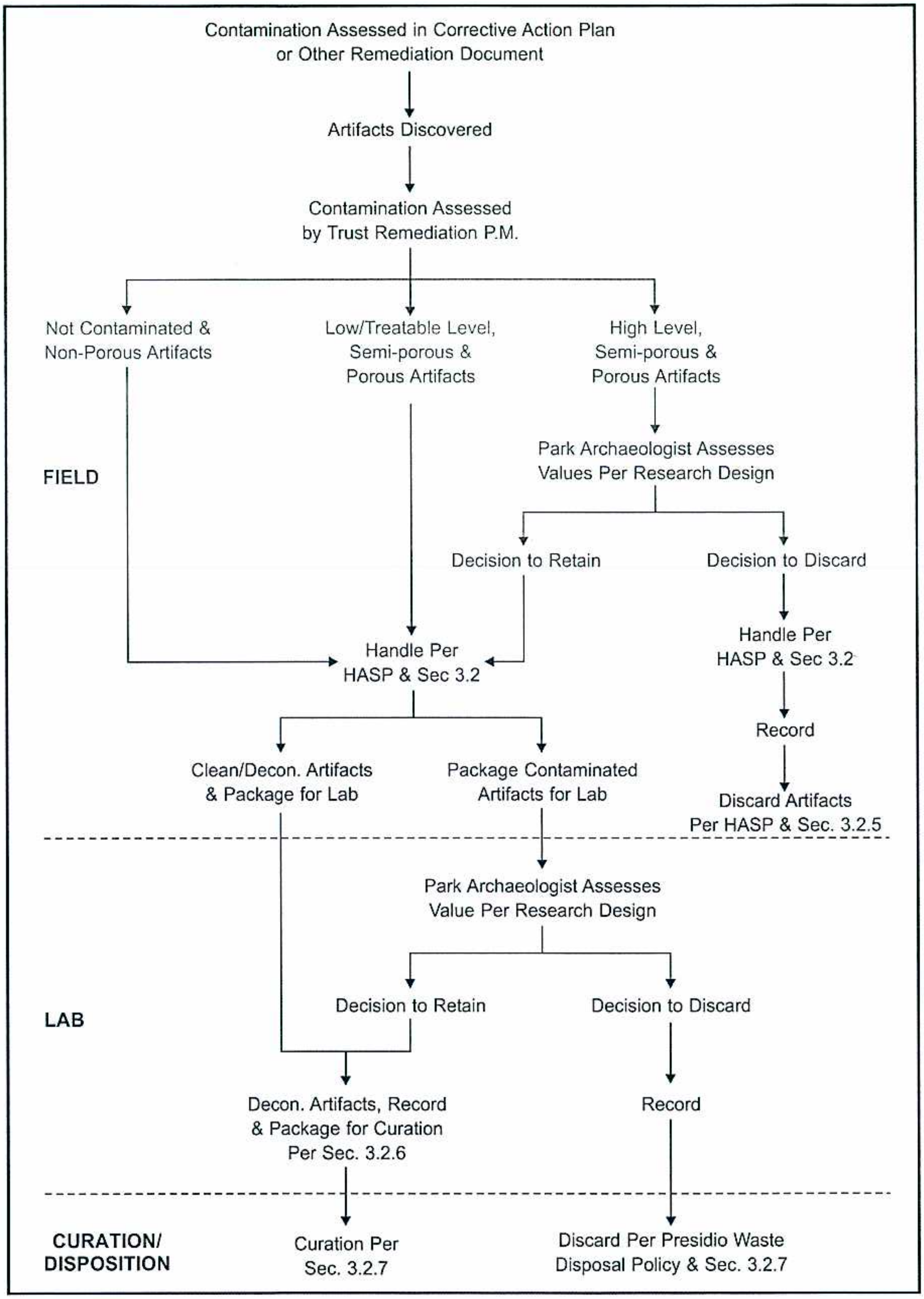

**Figure 2. Relative Porosity of Archaeological Remains**

| | RELATIVE POROSITY | | |
|---|---|---|---|
| | *Porous* | *Semi-porous* | *Non-porous* |
| *ORGANIC REMAINS* | | | |
| *Bone* | X | | |
| *Leather* | X | | |
| *Nut/seed* | X | | |
| *Textile/fabric* | X | | |
| *Wood/basketry/charcoal* | X | | |
| *Antler/horn* | | X | |
| *Ivory* | | X | |
| *Shell* | | X | |
| *INORGANIC REMAINS* | | | |
| *Earthenware* | X | | |
| *Brick (adobe)* | X | | |
| *Brick (low fired)* | | X | |
| *Brick (high fired)* | | | X |
| *Ferrous metals* | | | X |
| *Non-ferrous metals* | | | X |
| *Glass* | | | X |
| *Porcelain* | | | X |
| *Stone* | | | X |
| *Stoneware* | | | X |

**Figure 3. Handling Requirements for Archaeological Material by Work Phase**

| | Discovery/Field | Processing/Lab | Curation |
|---|---|---|---|
| **Porous** (e.g., bone[1], fabric) | Handle in accordance with HASP procedures and section 3.2 above; remove excess soil; place in plastic or paper bag or other container to protect structural integrity; if potentially contaminated, label per section 3.2.1 above; transport to lab. | Determine if residual contamination exists; handle in well ventilated environment in accordance with HASP procedures and section 3.2.6 above; rinse with water if not too fragile or clean by hand; standard conservation methods may be applied to non-contaminated materials; dispose of contaminated byproducts appropriately. | Handle cleaned items in accordance with HASP procedures and section 3.2.7 above; most items may be curated in a collection facility that meets the standards at 36CFR79 although some may warrant special conservation and/or storage measures; some items may retain residual contamination that would justify their discard once adequately documented. |
| **Semi-porous** (e.g., shell, low-fired brick) | Handle in accordance with HASP procedures and section 3.2 above until cleaned with water, a mild detergent (e.g., Alconox, Simple Green, etc.), and a brush to decontaminate; place in plastic or paper bag; transport to lab. | Determine if residual contamination exists; handle cleaned items in accordance with HASP procedures and section 3.2.6 above; standard conservation methods may be applied to non-contaminated materials. | Handle cleaned items in accordance with HASP procedures and section 3.2.7 above; curate in a collection facility that meets the standards at 36CFR79. |
| **Non-porous** (e.g., porcelain, glass, stone, metal) | Handle in accordance with HASP procedures and section 3.2 above until cleaned with water, a mild detergent (e.g., Alconox, Simple Green, etc.), and a brush to decontaminate; place in plastic or paper bag; transport to lab. | Handle cleaned items in accordance with HASP procedures and section 3.2.6 above; standard conservation methods may be applied. | Handle cleaned items in accordance with HASP procedures and section 3.2.7 above; curate in a collection facility that meets the standards at 36CFR79. |

[1] The treatment of human remains is described in section 5.4 of ITC's *Archaeological Protocols*. Potentially contaminated human remains should be handled with disposable gloves. Contaminated or not, all human remains must be handled and stored respectfully while they remain under Presidio Trust control.

# PROTOCOLS FOR CONTAMINATED ARCHAEOLOGICAL ARTIFACTS ON PRESIDIO PARK LANDS

Prepared for

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3 October 2005

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As sediments may contain contaminants, it is important to remove excess surface dirt from artifacts in the field by

- brushing or scraping, as appropriate
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- cleaning with a solution of Alconox or similar mild detergent, as appropriate

Cleaning with a detergent will, in many cases, decontaminate non-porous and some semi-porous artifacts and allow them to be handled using standard archaeological methods. It is important not to soak porous or semi-porous material or to remove surface treatments (such as decals) during washing or cleaning.

Plain water used to free artifacts of surface dirt may be reused by allowing sediments to accumulate in a series of settling tanks and recirculating the water by a pump. This process of extracting artifacts from their encasing matrix may create or release byproducts that may themselves contain contaminants. These byproducts include

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These byproducts must be handled, stored, and disposed of according to the HASP and Presidio waste storage policies.

### 3.2.3 Devitrification

Glass hydrates as it is exposed to the air and eventually may devitrify, becoming crazed and flaky. The scale that is created in this process may be harmful and can enter the skin through contact. Glass that shows signs of devitrification—such as iridescence—should be handled with disposable gloves.

### 3.2.4 Water-saturated materials

Porous and semi-porous materials from waterlogged environments should not be dried in the field. Excess liquids that may contain contaminants should not be collected and must be handled in accordance with HASP procedures. However, the artifact's current humidity level should be maintained while it is transported to the lab. In the case of fresh water saturation, this may be achieved by adding de-ionized water.

### 3.2.5 Discarding artifacts in the field

In some cases, a field decision may be made to discard certain artifacts rather than decontaminating and returning them to the lab. In this case, the materials may be simply recorded appropriately and placed back into the excavation.

### 3.2.6 Lab processing

In most cases, artifacts will have been decontaminated in the field before entering the lab. If contaminated materials must be brought into the lab they must be separated from the remainder of the collection. The type of suspected contaminant must be clearly marked on the outside of the box or other container. These artifacts must be handled in accord with the HASP.

When it is necessary to clean and decontaminate artifacts in the lab, arrangements must be made to dispose of any contaminated byproducts before they are created. These byproducts must be handled, stored, and disposed of according to the HASP and Presidio waste storage and disposal policies. When the decision is made in the lab to discard contaminated artifacts, these items must also be disposed of according to Presidio waste storage and disposal policies.

Contaminated artifacts may only be submitted for curation in exceptional circumstances and with the permission of the Presidio archaeologist. In this case, the artifacts must be packaged to confine the contaminant and the type of contamination must be clearly marked on the outside of the box or container.

### 3.2.7 Curation

Federal curation standards at 36CFR79 require that archaeological remains be handled, stored, cleaned, and conserved in a manner that protects them from breakage and possible deterioration from adverse temperature and relative humidity, visible light, ultraviolet radiation, dust, soot, gases, mold, fungus, insects, rodents and general neglect, as well as preserving data that may be studied in future laboratory analyses.

In most cases, contaminated artifacts will have been treated in the field or lab. Thus, handling these materials after curation should not require special measures in addition to standard archaeological curation practices. Any contaminated artifacts must be handled in accord with the HASP.

## REFERENCES

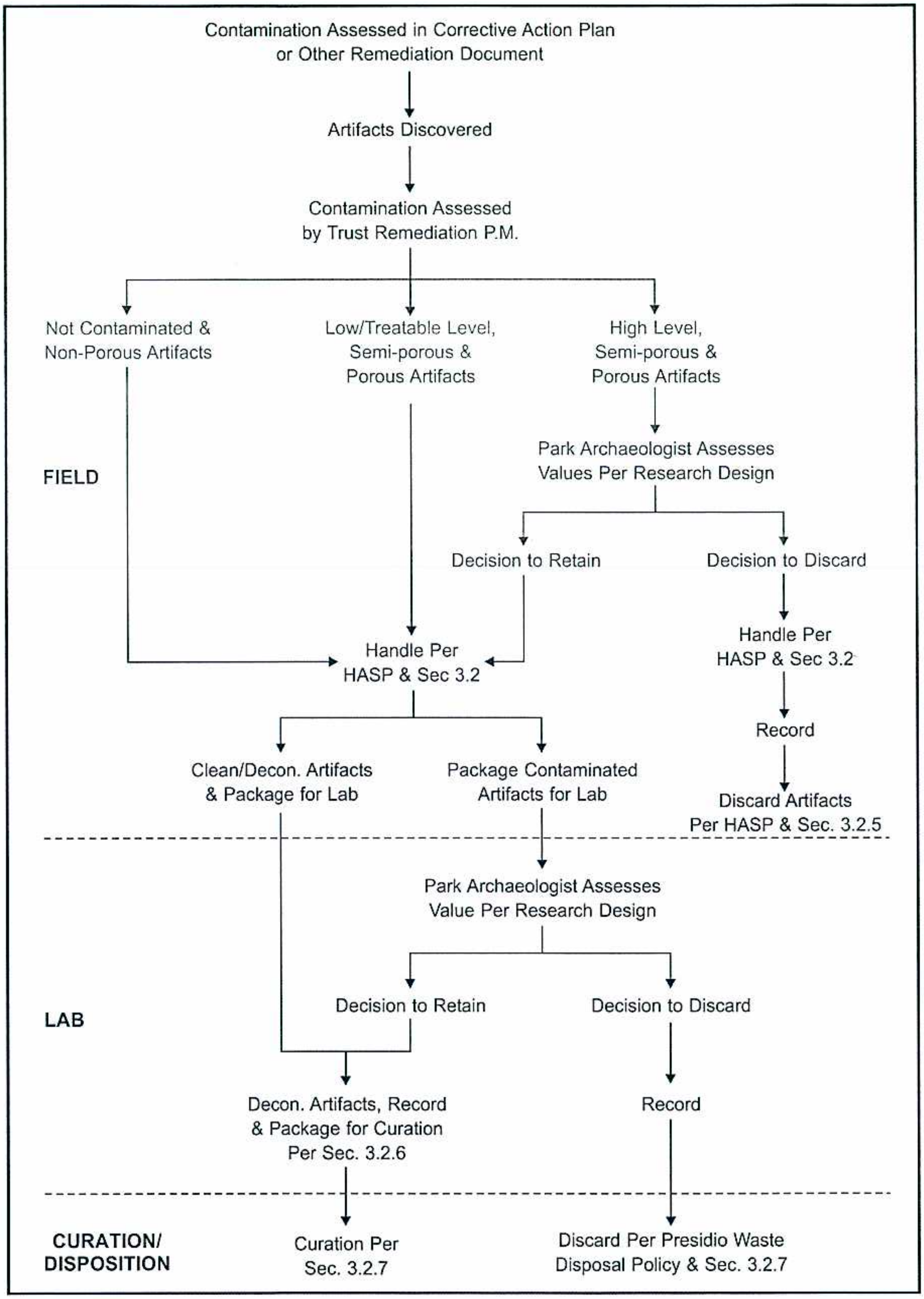
36 Code of Federal Regulations Part 79

*Curation of Federally Owned and Administered Archaeological Collections* (Authority: 16 US Code 470 et seq.)

International Technology Corporation (ITC)

1996 Archaeological Protocols, IT Archaeological Program, Presidio of San Francisco, San Francisco, California. IT Corporation, Martinez, CA, prepared for USA Corps of Engineers, Sacramento. CA.

**Figure 1. Decision Procedures for the Collection of Archaeological Artifacts**



## Figure 2. Relative Porosity of Archaeological Remains

| | RELATIVE POROSITY | | |
|---|---|---|---|
| | *Porous* | *Semi-porous* | *Non-porous* |
| *ORGANIC REMAINS* | | | |
| *Bone* | X | | |
| *Leather* | X | | |
| *Nut/seed* | X | | |
| *Textile/fabric* | X | | |
| *Wood/basketry/charcoal* | X | | |
| *Antler/horn* | | X | |
| *Ivory* | | X | |
| *Shell* | | X | |
| *INORGANIC REMAINS* | | | |
| *Earthenware* | X | | |
| *Brick (adobe)* | X | | |
| *Brick (low fired)* | | X | |
| *Brick (high fired)* | | | X |
| *Ferrous metals* | | | X |
| *Non-ferrous metals* | | | X |
| *Glass* | | | X |
| *Porcelain* | | | X |
| *Stone* | | | X |
| *Stoneware* | | | X |

**Figure 3. Handling Requirements for Archaeological Material by Work Phase**

| | Discovery/Field | Processing/Lab | Curation |
|---|---|---|---|
| **Porous** (e.g., bone[1], fabric) | Handle in accordance with HASP procedures and section 3.2 above; remove excess soil; place in plastic or paper bag or other container to protect structural integrity; if potentially contaminated, label per section 3.2.1 above; transport to lab. | Determine if residual contamination exists; handle in well ventilated environment in accordance with HASP procedures and section 3.2.6 above; rinse with water if not too fragile or clean by hand; standard conservation methods may be applied to non-contaminated materials; dispose of contaminated byproducts appropriately. | Handle cleaned items in accordance with HASP procedures and section 3.2.7 above; most items may be curated in a collection facility that meets the standards at 36CFR79 although some may warrant special conservation and/or storage measures; some items may retain residual contamination that would justify their discard once adequately documented. |
| **Semi-porous** (e.g., shell, low-fired brick) | Handle in accordance with HASP procedures and section 3.2 above until cleaned with water, a mild detergent (e.g., Alconox, Simple Green, etc.), and a brush to decontaminate; place in plastic or paper bag; transport to lab. | Determine if residual contamination exists; handle cleaned items in accordance with HASP procedures and section 3.2.6 above; standard conservation methods may be applied to non-contaminated materials. | Handle cleaned items in accordance with HASP procedures and section 3.2.7 above; curate in a collection facility that meets the standards at 36CFR79. |
| **Non-porous** (e.g., porcelain, glass, stone, metal) | Handle in accordance with HASP procedures and section 3.2 above until cleaned with water, a mild detergent (e.g., Alconox, Simple Green, etc.), and a brush to decontaminate; place in plastic or paper bag; transport to lab. | Handle cleaned items in accordance with HASP procedures and section 3.2.6 above; standard conservation methods may be applied. | Handle cleaned items in accordance with HASP procedures and section 3.2.7 above; curate in a collection facility that meets the standards at 36CFR79. |

[1] The treatment of human remains is described in section 5.4 of ITC's *Archaeological Protocols*. Potentially contaminated human remains should be handled with disposable gloves. Contaminated or not, all human remains must be handled and stored respectfully while they remain under Presidio Trust control.

# APPENDIX E

# IN SITU REMEDIATION AT HISTORIC WALL INTERFACE: NORTHERN PORTION OF BUILDING 228 REMEDIAL UNIT AND SOUTHERN PORTION OF BUILDING 231 REMEDIAL UNIT

# CONTENTS



## FIGURES



## ATTACHMENTS

# E1.0 INTRODUCTION

In situ remediation is the corrective action selected in the CAP and CAP Addendum for saturated soils and groundwater within the "historic wall interface" that is defined by the portions of the Building 231 and 228 remedial units (RUs) that abut the historic wall designated for preservation, and can not be excavated without endangering its structural integrity. This appendix presents the recommended in situ remediation approach that will be implemented by MACTEC prior to excavation of the downgradient portion of the Building 231 RU, and:

- Summarizes the remedial evaluations conducted based on existing data, and the results of the evaluations that were used to compare in situ remediation data from the similar Building 637 CAP Site, and determine the design basis and assumptions for selection of in situ remediation compounds;

- Describes the in situ remediation approach to be implemented as part of the corrective action, and the compounds selected for injection, their estimated quantities, and proposed application intervals and methods; and

- Summarizes the components of the corrective action included in the post-injection follow up process that will be used to assess the effectiveness of the in situ remediation approaches selected for implementation.

***Definition of Historic Wall Interface***

The historic wall interface is defined as follows:

(1) The southern portion of the Building 231 RU as defined by a "wedge" of soil contamination of soil within the excavation setback defined in Appendix L (Geotechnical Recommendations for Excavation Setbacks) that will not be excavated and extends from the northern edge of the historic wall to approximately 5 feet north of the wall at the surface of the RU, and slopes downward to the bottom of the wedge that corresponds with a lateral distance of approximately 10 feet north of the wall (Figure E-2); and extends laterally over a span of approximately 30 feet (Figure E-1); and

(2) The northern portion of the Building 228 RU as defined by the approximate 15-foot wide area between the northern edge of the Building 228 foundation and the southern edge of the historic wall (Figure E-2), through a depth interval of approximately 6 to 20 feet bgs (based on the ground

surface elevation behind the wall), and that extends laterally over a span of approximately 40 feet (Figure E-1).

***Purpose and Objectives***

The purpose of injecting in situ remediation compounds within the historic wall interface is to enhance the oxidation and stimulate aerobic biodegradation of petroleum hydrocarbon contaminants in the subsurface that exceed cleanup levels in: (1) saturated soils and groundwater within the smear zone, and (2) groundwater within the radius of influence of the injection areas. The primary chemicals of concern (COCs) in soil and groundwater at the interface include TPH as gasoline (TPHg) and TPH as diesel (TPHd) that are present in subsurface soils and groundwater as shown on Figure 1-7 of the Work Plan.

The primary objectives of conducting in situ remediation at the historic wall interface are: (1) to reduce concentrations of petroleum-related COCs in soil and groundwater below cleanup levels through in situ remediation where excavation can not be performed without endangering the structural integrity of the historic wall and buildings: and (2) to mitigate the potential upgradient source of contamination to the extent practicable prior to excavation of the Building 231 RU soils directly downgradient.

***Summary of Proposed In Situ Remediation Approach***

The approved corrective action for the portions of the Building 231 RU and Building 228 RU that occurs in the southern portion of the Site at the historic wall interface, consists of in situ remediation on both sides of the historic wall. New data collected adjacent to the historic wall since the CAP was prepared (within the Building 231 RU and directly downgradient of the Building 228 RU) indicates concentrations of petroleum hydrocarbons are above previously documented concentrations and/or cleanup levels. Therefore, the CAP Addendum documented the revised corrective action for combined remediation of both portions of the Building 231 and 228 RUs in this area.

As the first step of the combined approach to in situ remediation on both sides of the wall, samples will be collected and analyzed for COCs from four soil borings, 2 each on the eastern and western sides of the portion of the Building 231 RU defined as the “wedge” of soil within the excavation setback. After data has been analyzed to further evaluate the extent of contamination and potentially revise the design parameters for in situ remediation, the chemical oxidation compound (RegenOxTM) will be injected within the Building 231 RU in a series of four injection events over a period of approximately 6 weeks, with the intent of aggressively oxidizing and stimulating biodegradation to significantly reducing

petroleum hydrocarbon concentrations where they are documented as above cleanup levels in soil and groundwater within this area.

Approximately one month after in situ remediation using RegenOxTM is completed within the Building 231 RU, a time-released oxygen releasing compound (ORC AdvancedTM ) will then be injected within both the Building 231 and 228 RUs with the intent of stimulating biodegradation of lower-level residual petroleum hydrocarbons and reducing concentrations in the saturated zone of the subsurface below cleanup levels as a final “polishing” step over a period of approximately 12 months. As a contingency, the corrective action may also include injection of RegenOxTM within the Building 228 RU prior to injection of ORC AdvancedTM, if based on an evaluation of the results of sampling within the Building 231 RegenOxTM injection area and in consultation with Regenesis, Inc. (the manufacturer of both compounds) and stakeholders, it is indicated as a beneficial adjunct to the remediation approach in meeting cleanup levels in the northern portion of the RU.

### E-1.1 Evaluation of Existing Data at Historic Wall Interface

This section summarizes the evaluation of existing data that was used to compare in situ remediation data from the similar Building 637 CAP Site in Section E-1.2, and determine the design basis and assumptions for selection of in situ remediation compounds summarized in Section E-2.0.

#### *Evaluation of Existing Data for Building 231 RU*

MACTEC performed an evaluation of available RU-specific data for the southern portion of the Building 231 RU that included: (1) soil and groundwater sampling data presented in the CAP, and (2) soil and groundwater data from the new well pair (231GW200A/200B) installed within this area in between January 28 and February 6, 2008 (See Attachment E-1; Monitoring Well Installation Report, T&R, 2008). Because a groundwater monitoring well was not present within the historic wall interface to provide reproducible data on groundwater contamination and conditions downgradient of the proposed in situ remediation area at the Building 228 RU, as recommended in the CAP, the Trust installed the new well pair, 231GW200A/200B, within the Building 231 RU as shown on Figure E-1. Soil data collected during well installation, and two quarters of groundwater monitoring data (Quarters 1 and 2, 2008) from the newly installed well pair was evaluated. This data is summarized on Figure 1-7 of the Work Plan, and cleanup level exceedances are posted on the cross-section shown on Figure E-2.

The existing available data indicated the following:

- The historic data documented in the CAP for the southern portion of the RU indicated petroleum hydrocarbon contamination is present above cleanup levels in seasonally saturated soils and groundwater between 1 to 11 feet bgs within the "wedge" of soil contamination that will not be excavated within the 5-foot setback area that extends approximately 30 feet to the east and west (Figure E-1). Four investigatory borings will be sampled for petroleum-related COCs in soil and groundwater to the east and west of this 30-foot span of known contamination prior to in situ remediation of this area in order to further characterize the eastern and western extent of contamination within the "wedge" area. This area is co-located with a groundwater RU likely associated with the upgradient former Building 228 USTs (Figures E-1 and E-2).

- The data collected from the new well pair adjacent to the historic wall since the CAP was prepared indicates concentrations of petroleum hydrocarbons are above previously documented concentrations and/or cleanup levels in groundwater. Therefore, the CAP Addendum documented the revised corrective action for combined remediation of both portions of the Building 231 and 228 RUs in this area, because petroleum hydrocarbon contamination in groundwater on the northern and southern sides of the wall appears to be interconnected as interpreted on the cross-section shown on Figure E-2.

- Soil sample data collected from the 231GW200B well installation boring confirmed concentrations of TPHg in soil are higher in shallow soils (1,500 mg/kg at 3.0 feet bgs) than in deeper Bay Mud soils (32 mg/kg at 12.5 feet bgs). This data confirms TPHg is present in shallow soils at concentrations above the cleanup level of 11.6 mg/kg, but is not present in deeper Bay Mud soils above the cleanup level.

- Groundwater data was collected from the new well pair 231GW200A screened in the shallow groundwater zone (fill material), and 231GW200B screened in the intermediate groundwater zone (poorly graded sand): (1) approximately one month after installation and development of the new well pair during the Quarter 1 sampling event, and (2) approximately three months later during the Quarter 2 sampling event.

  - For well 231GW200A screened in the shallow groundwater zone, the data showed that the concentration of TPHg in groundwater from the Quarter 1 sampling event (180 mg/L) was approximately 30 times higher than in the Quarter 2 sampling event (4.9 mg/L). These data

confirm that TPHg is present in groundwater in the shallow groundwater zone at concentrations above the cleanup level of 0.443 mg/L. In addition, the relatively higher TPHg concentration in groundwater in Quarter 1 was likely due to TPHg in soil around the well boring being disturbed and desorbed into groundwater during well installation and development activities. The Quarter 2 sampling results are likely more representative of stabilized dissolved contaminant concentrations in groundwater in this area. Further sampling will be performed to confirm that the concentrations observed in Quarter 2 are representative of stabilized dissolved contaminant concentrations.

- For well 231GW200B screened in the underlying intermediate groundwater zone, the data showed that the concentration of TPHg in groundwater from the Quarter 1 sampling event (0.24 mg/L) was approximately 4 times higher than in the Quarter 2 sampling event (0.063 mg/L). These data confirm that TPHg is not present in groundwater in the intermediate groundwater zone at concentrations above the cleanup level of 0.443 mg/L. In addition, as with well 231GW200A, the data indicate the initial spike in TPHg concentration in groundwater in Quarter 1 was due to soil being disturbed during well installation and development activities, and that Quarter 2 sampling results are likely more representative of stabilized dissolved contaminant concentrations in groundwater in the intermediate groundwater zone. Further sampling will be performed to confirm that the concentrations observed in Quarter 2 are representative of stabilized dissolved contaminant concentrations.

- Review of redox parameter data collected during groundwater monitoring at the new well pair (see Table 2-1 of the Work Plan) did not indicate any significant difference in the levels or presence of these parameters compared to historic data; however; the data was considered in the design basis and updated as appropriate for use in the in situ remediation compound software modeling conducted by Regenesis as described below and in Attachment E-2.

### *Evaluation of Existing Data for Building 228 RU*

MACTEC performed an evaluation of available RU-specific data from the CAP for the northern portion of the Building 228 RU that included soil and groundwater grab samples collected prior to preparation of the CAP. Because a groundwater monitoring well is not present within this RU to provide reproducible data on groundwater contamination and conditions, data from the newly installed well pair, 231GW200A/200B described above will be evaluated as a downgradient monitoring point. However, because the new well pair is located within the portion of the Building 231 RU described above for which

recent data indicates cleanup level exceedances are present at that location, the initial phase of in situ remediation of the area using a chemical oxidant will be implemented to reduce concentrations in situ prior to using the data as an indicator of conditions upgradient within the Building 228 RU. After the first phase of injection at the Building 231 RU is completed and monitoring data is available to assess post-injection concentrations of COCs and conditions in the new well pair, if the COC concentrations in groundwater are lower or higher than those used in the design assumptions described in Section 2.0 (9.6 milligrams per liter[mg/liter], 0.09 mg/liter for both ethylbenzene and xylenes) to calculate the ORC AdvancedTM injection rates for either the Building 228 RU or Building 231 RU, the ORC AdvancedTM injection rates will be recalculated. If the data indicates that a lower or higher injection rate is warranted, then this assessment and any recommendations will be provided to stakeholders prior to implementation of ORC AdvancedTM injection.

The existing available data also indicated the following:

- The northern portion of the Soil RU at this area is co-located with a groundwater RU associated with the former Building 228 USTs (Figure E-1). The areas of soil containing COCs above cleanup levels are located between historic Building 228 and the historic wall in the vicinity of the excavation area associated with the former 228 USTs.

- The northern portion of the Soil RU is located in unsaturated and saturated soil between 1 to 11 feet bgs that extends approximately 40 feet to the east and west. The petroleum-related COCs that were detected in soil at concentrations above cleanup levels in the northern portion of the Soil RU include TPHg, TPHd, TPHfo, ethylbenzene, and xylenes. The COCs that were detected in groundwater at concentrations above cleanup levels in the northern portion of the Soil RU include: TPHg, TPHd, TPHfo; ethylbenzene, and xylenes; 1,2-dichlorobenzene (1,2-DCB).

### E-1.2 Evaluation and Comparison of Data from Building 637 CAP Site

This section summarizes (1) the evaluation of existing data from in situ remediation of the similar Building 637 CAP Site, and (2) the conclusions resulting from a comparison of data from both sites used in consideration of the design basis and assumptions for selection of in situ remediation compounds summarized in Section E-2.0.

In 1999 and 2000, oxygen releasing compound was applied to soil to treat residual petroleum hydrocarbon contamination in soil at the Building 637 CAP Site (EKI, 1999a, 1999b, 2000, 2004). The site conditions and application quantities used at the Building 637 CAP Site were reviewed to provide

supporting data to assist in the evaluation and development of the proposed application quantity of oxygen releasing compound at the historic wall interface at the Building 207/231 CAP Site.

### *Comparison of Site Conditions at Building 637 CAP Site*

The Building 637 CAP Site and Building 231 and 228 RUs at the historic wall interface are similar in terms of (1) soil types consisting of fill underlain by silty sands and Bay Mud, (2) depth to groundwater, and (3) the type and distribution of petroleum contamination, as described below.

***Comparison of Soil Types and Depth to Groundwater:*** Soils at the Building 637 CAP Site consist of fill material and naturally occurring interbedded fine-grained estuarine and sand deposits. Fill material extends 8 to 9 feet below ground surface (bgs). Monitoring wells are installed in two distinct water bearing zones: A1 and A2. Groundwater is typically encountered from 3 to 9 feet bgs in the A1 zone and 4 to 7 feet bgs in the A2 zone.

The Building 231 and 228 RUs at the historic wall interface are also underlain by fill and native deposits consisting of clayey or silty sand, Bay Mud, and silt (Figure E-2). The depths and thicknesses of these deposits and groundwater vary across the site; however, fill and shallow sands generally extend to depths of approximately 8 to 10 feet bgs near the historic wall. Groundwater is typically encountered at depths of approximately 1.5 to 10 feet bgs in the shallow zone. Intermediate groundwater is separated from shallow groundwater by the Bay Mud, which extends from depths of approximately 9 to 15 feet bgs.

***Comparison of Nature and Extent of COCs:*** Soil and groundwater at both sites has been impacted by leaking petroleum fuel tanks and/or fuel distribution systems and share the following petroleum-related chemicals of concern (COCs): primarily TPHg; TPHd, TPHfo, with some VOC detections such as ethylbenzene (Building 228) and benzene (Building 637). The range of concentrations of petroleum-related COCs in soil and groundwater are similar at both sites.

### *Evaluation of Oxygen Releasing Compound and Application Quantities at Building 637 CAP Site*

Petroleum-impacted soil was excavated by the Trust at six areas (Areas A, B, C, D, E, and F) at the Building 637 CAP Site (*EKI, 1999a, 1999b, 2000, 2004)*. Oxygen releasing compound was applied to excavations at Areas C and F during backfilling and was applied via injection at an area located between two previous excavations conducted by the Army (referred to as the "area between the Army excavations") (see Attachment E-3, Extent of Excavations and ORC Treatment Area Maps, Building 637 CAP Site).

The specific oxygen releasing compound used at Building 637 CAP Site was Oxygen Release Compound (ORC) manufactured by Regenesis Technical Support (Regenesis). ORC is a magnesium peroxide based compound. In contrast, ORC Advanced™ is proposed for use at the historic wall interface, which is a calcium peroxide based compound. Regenesis modified and improved its oxygen releasing compound since the Building 637 CAP Site work was conducted; therefore it is not possible to provide a direct comparison between ORC application quantities between these two sites.

At the Building 637 CAP Site, the estimated mass of hydrocarbons present in residual soil was determined for soil at Area F and the area between the Army excavations (*EKI, 1999b)*. Based on site-specific soil data and COC concentrations collected from the Building 637 CAP Site, the Trust's contractor, Erler and Kalinowski, Inc. (EKI), estimated 21,800 lbs of hydrocarbons (1,800 lbs TPHg in Area F and 20,000 lbs TPHd in the area between the Army excavations) were present in the smear zone soils. Based on site-specific groundwater data from the Building 637 CAP Site, EKI estimated approximately 7 to 10 pounds of hydrocarbons were present in groundwater. However, due to the disparity in the mass estimates using soil and groundwater data, EKI used the ORC application quantity that Regenesis recommended. Approximately 1,320 pounds (lbs) of ORC (0.3 percent ORC by weight of treated soil) was applied to the excavations at Areas C and F. Similarly, the quantity of ORC injected in the area between the Army excavations was based on Regenesis' recommendations. Approximately 2,690 lbs of ORC was applied via injection.

### *Evaluation of Groundwater Monitoring Data at Building 637 CAP Site*

The results of groundwater monitoring at the Building 637 CAP Site indicated that source removal and ORC application in excavations and by injection was effective in reducing concentrations of petroleum-related COCs in groundwater at the site to levels below applicable cleanup levels. ORC was applied within the excavated areas prior to backfilling and via injection points in a separate area between excavations where soil was not excavated. Three monitoring wells located immediately downgradient of the ORC application area were monitored prior to the ORC injection to establish a baseline for evaluating the effectiveness of the source removal and ORC application. Baseline monitoring was performed four months after placement of the ORC in the excavation, and 20 days prior to injection. Quarterly sampling was conducted for two years after the ORC was applied. Based on groundwater monitoring results, concentrations of COCs in groundwater decreased or remained below cleanup levels (see Attachment E-3, Groundwater Monitoring Results, Building 637 CAP Site).

### *Summary of Data Comparison Between Building 637 CAP Site and Historic Wall Interface*

The following conclusions resulting from (1) the evaluation and comparison of data from the two sites; and (2) Regenesis' experience and recommendations regarding the two sites, were considered in the development of the proposed oxygen releasing compound design for the historic wall interface presented in Section E-2.0:

- The specific oxygen releasing compound used at Building 637 CAP Site was Oxygen Release Compound (ORC™) manufactured by Regenesis Technical Support (Regenesis). ORC™ is a magnesium peroxide based compound. In contrast, ORC Advanced ™ is proposed for use at the historic wall interface, which is a calcium peroxide based compound. Regenesis modified and improved its oxygen releasing compound since the Building 637 CAP Site work was conducted; therefore it is not possible to provide a direct comparison between ORC application quantities between these two sites.

- Although the sites are similar in terms of (1) soil types, (2) depth to groundwater, and (3) the type and distribution of petroleum contamination, the recommended application rates for the historic wall interface are higher than those applied at Building 637 CAP site. An additional margin of oxygen-release dosage is recommended by Regenesis for the historic wall interface to address the expected higher oxygen demand from organic materials present in the Bay Mud underlying the site. Based on Regenesis' experience in the several years since the ORC™ design was prepared for the Building 637 CAP Site, they now recommend more than twice the oxygen dosage to meet the high oxygen demand present in a Bay Mud environment such as is present at the historic wall interface.

- Application of ORC Advanced™ via injection is anticipated to be effective and is proposed for treatment of residual petroleum contamination. The application of ORC™ via injection at the Building 637 CAP Site is likely to have contributed to reducing petroleum-related COC concentrations in groundwater below cleanup levels, but can not be wholly assessed on its own merits because it was implemented in conjunction with application of ORC in excavations prior to backfilling, as well as source removal by excavation.

- The quantity of oxygen-releasing compounds recommended for application at the two sites are similar; however, as noted above, the formulations (type of compound and percent oxygen they are designed to deliver) and method of application differ and so can not be directly compared. A total of approximately 4,010 lbs. of ORC™ was applied at the Building 637 CAP Site, of which

approximately 2/3 was applied via in situ injection in the plume area between excavations—approximately 1,320 pounds (lbs) of ORC™ (0.3 percent ORC by weight of treated soil) was applied in excavation bottoms prior to backfilling at Areas C and F, and approximately 2,690 lbs. was applied via injection between excavations. In comparison, as presented in Section E-2.0, a total of approximately 2,475 lbs. of ORC Advanced ™ (0.4 percent ORC by weight of treated soil) is recommended by Regenesis for application at the historic wall interface—approximately 1,025 lbs. within the Building 228 RU, and approximately 1,450 lbs. at the Building 231 RU. The application of ORC Advanced ™ will be implemented after in situ application of approximately 4,050 lbs. of RegenOx™ within the Building 231 RU with the intent of accelerating and significantly reducing petroleum-related COC concentrations via chemical oxidation to within a range appropriate for time-release application of ORC Advanced™ for treatment of residual concentrations.

# E-2.0 DESIGN BASIS FOR PROPOSED IN SITU REMEDIATION AT THE HISTORIC WALL INTERFACE

Based on MACTEC's evaluation of site data at the historic wall interface conducted in consultation with Regenesis, Inc., MACTEC will implement in situ remediation of petroleum-related contamination above cleanup levels in saturated soils and groundwater in accordance with the Letter Proposal recommendations prepared by Regenesis provided in Attachment E-2. MACTEC will contract with and oversee the direct push injection subcontractor who will inject the in situ remediation compounds through overlapping direct push technology (DPT) injection points.

This section:

- Describes the in situ remediation approach to be implemented as part of the corrective action, and the compounds selected for injection, their estimated quantities, and proposed application intervals and methods; and
- Summarizes the components of the corrective action included in the post-injection follow up process that will be used to assess the effectiveness of the in situ remediation approaches selected for implementation.

## E-2.1 Design Basis and Proposed Injection Methodology

This section summarizes the design basis and proposed injection methodology presented in Attachment E-2, Regenesis Letter Proposals for in situ remediation of the Building 231 and Building 228 RUs. As described in Section E-1.0, the in situ remediation approach consists of the following two steps:

**Step 1: Sampling and RegenOx™ Injection at Building 231 RU**

Soil samples will be collected and analyzed for petroleum-related COCs from four soil borings; two will be installed on both the eastern and western sides of the portion of the Building 231 RU defined as the "wedge" of soil within the excavation setback at the proposed locations shown on Figure E-1 and Figure I-1 of Appendix I (Confirmation Sampling Plan) to the Work Plan. Soil samples will be collected at depths of 3 and 8 feet bgs within the shallow groundwater zone where contamination is known to be present adjacent to this area, and a grab groundwater sample will also be collected if there is evidence of free product. This data will be analyzed to further evaluate the lateral extent to the east and west of contamination that may be present within the setback above cleanup levels. If concentrations of COCs in any of the samples exceed cleanup levels, the design

parameters for in situ remediation will be reevaluated and any revisions to the approach will be communicated to stakeholders. If concentrations of COCs in the samples do not exceed cleanup levels, the chemical oxidation compound (RegenOx$^{TM}$) will be injected within the Building 231 RU in a series of four injection events over a period of approximately 6 weeks, with the intent of rapidly oxidizing and significantly reducing petroleum hydrocarbon concentrations where they are documented as above cleanup levels in soil and groundwater within this area.

The design basis for RegenOx$^{TM}$ injection at the Building 231 RU was developed by Regenesis in consultation with MACTEC, and included Regenesis' review of current site data summarized in Section E-1.0 and as presented in the "Data and Assumptions", and software modeling to determine the application parameters as shown on the "Summary Page" model calculation sheets of the July 10, 2008 Letter Proposal included in Attachment E-2. As shown on Figures E-1 and E-2, 12 injection points will be advanced within the 30 by 10 foot area on 5-foot centers using DPT technology, and the RegenOx$^{TM}$ slurry will be injected within each of the points from approximately 1 to 11 feet bgs, with the intention of distributing RegenOx$^{TM}$ compound throughout the saturated zone of contamination. Approximately two weeks, four weeks, and six weeks after the first injection event, the process will be repeated for 12 injection points offset by 1.25 feet laterally at each event, thereby providing a total of 48 overlapping injection locations and closely-spaced delivery of RegenOx$^{TM}$ within the in situ treatment area. Approximately 1,260 pounds of RegenOx$^{TM}$ will be injected during each of the four events; therefore, approximately 105 pounds will be injected at each of the points, for a total of 5,040 pounds delivered at 48 points over the four events.

**Step 2: ORC Advanced$^{TM}$ Injection at Building 231 and 228 RUs**

If the results of sampling conducted at the Building 231 RU described above generates a different design basis for the RegenOx$^{TM}$ injection than described herein, this data will be analyzed prior to injection of ORC Advanced$^{TM}$ at the Building 231 and 228 RUs to reevaluate the design parameters for in situ remediation; any revisions to the approach described herein will be communicated to stakeholders prior to implementation of injection activities. In addition, groundwater samples will be collected from the new well pair 231GW200A/200B and will be analyzed for COCs to confirm the reduction in concentrations of COCs resulting from RegenOx$^{TM}$ injection is within the range of concentrations assumed in the design basis for ORC Advanced injection at both the Building 231 and 228 RUs. As a contingency, the corrective action may also include injection of RegenOx$^{TM}$ within the Building 228 RU prior to injection of ORC Advanced$^{TM}$, if based on an evaluation of the

results of sampling within the Building 231 RegenOx™ injection area and in consultation with Regenesis, Inc. (the manufacturer of both compounds) and stakeholders, it is indicated as a beneficial adjunct to the remediation approach in meeting cleanup levels in the northern portion of the RU.

Within approximately one month after in situ remediation using RegenOx™ is completed within the Building 231 RU, a time-released oxygen releasing compound (ORC Advanced™) will then be injected within both the Building 231 and 228 RUs with the intent of stimulating biodegradation of lower-level residual petroleum hydrocarbons and reducing concentrations in the saturated zone of the subsurface below cleanup levels as a final "polishing" step over a period of approximately 12 months.

The design basis for ORC Advanced™ injection at the Building 231 and 228 RUs were developed by Regenesis in consultation with MACTEC, and included Regenesis' review of current site data summarized in Section E-1.0 and as presented in the "Data and Assumptions", and software modeling to determine the application parameters as shown on the "Summary Page" model calculation sheets of the July 10, 2008 Letter Proposal (for Building 231 RU) and December 4, 2006 Letter Proposal (for Building 228 RU) included in Attachment E-2.

As shown on Figures E-1 and E-2, within the Building 231 RU, 12 injection points will be advanced within the 30 by 10 foot area on 5-foot centers east to west in each row, with four points per row within each of three rows, using DPT technology, and the ORC Advanced™ slurry will be injected within each of the points from approximately 1 to 11 feet bgs, with the intention of distributing RegenOx™ compound throughout the saturated zone of contamination. Approximately 1,450 pounds of ORC Advanced™ will be injected within this RU, for a total of approximately 120 pounds within each 10-foot deep injection point (or approximately 12 pounds per foot). As shown on Figures E-1 and E-2, within the Building 228 RU, 12 injection points will be advanced within the 40 by 10 foot area on 10-foot centers in each row, with four points per row within each of three rows, using DPT technology, and the ORC Advanced™ slurry will be injected within each of the points from approximately 6 to 20 feet bgs, with the intention of distributing RegenOx™ compound throughout the saturated zone of contamination. Approximately 1,025 pounds of ORC Advanced™ will be injected within this RU, for a total of approximately 85 pounds within each 14-foot deep injection point (or approximately 6.1 pounds per foot).

The proposed application designs are labeled in the Proposal Letters as "preliminary" in order to allow for flexibility in adapting the design, if necessary, based on evaluation of additional groundwater monitoring data from new well pair 231GW200A/200B, that will be collected between the date of publication of this Work Plan, and field implementation of RegenOx™ and ORC Advanced™ injection. If the data indicates that a lower or higher injection rate is warranted, then this assessment and any recommendations will be provided to stakeholders prior to implementation of ORC injection in a weekly stakeholder meeting.

### *Injection Application Procedures*

MACTEC will subcontract with a driller who will drill the injection points with a direct push drill rig. The twelve injection points will be drilled as described above and shown on Figure E-1 (also see Attachment E-2). Each injection point will be drilled throughout the saturated zone of detectable petroleum-related COCs in soil and/or groundwater (anticipated to be approximately 1 to 11 feet bgs at the Building 231 RU, and 6 to 20 feet bgs at the Building 228 RU). The slurry will be mixed in a ratio of 30 to 40 percent solids to clean water or as indicated in Regenesis' recommendation presented with the Letter Proposal in Attachment E-2, and will be injected at the design rate noted above.

The oxygen releasing compound slurry will be delivered to the subsurface under variable pressure (depending on the formation variability in the fourteen-foot vertical interval) using DPT methods, in a manner consistent with the manufacturer's recommended application guidelines presented in Attachment E-2. The calculated volume of oxygen releasing compound should introduce sufficient oxygen into the surrounding sub-surface soils to reverse the local reducing conditions that have been observed at the Site and stimulate aerobic hydrocarbon degrading bacteria to reproduce and break down residual hydrocarbons present in saturated soils and groundwater. As described above, the new monitoring well pair will be sampled in advance of each injection event, and will be used to monitor the effectiveness of the compounds in reducing concentrations of COCs below cleanup levels, and performance monitoring and in situ confirmation sampling will be performed as described below.

## E-2.2 Post-Injection Performance Monitoring

Groundwater monitoring will be conducted downgradient of the Building 228 RU at new well pair 231 GW200A/200B at the post-injection frequency presented in Table 2-1 of the Work Plan for chemical analysis for petroleum-related contaminants including:

- Total petroleum hydrocarbons (TPH) quantified as diesel and fuel oil by EPA Test Method 8015M with silica gel cleanup;
- TPH quantified as gasoline by EPA Test Method 8015M;
- BTEX/MTBE by EPA Test Method 8021; and
- Polynuclear aromatic hydrocarbons (PAHs) by EPA Test Method 8270SIM.

These chemical data will be used to evaluate concentrations of petroleum related contaminants in groundwater at the historical wall interface.

The collected groundwater samples will be submitted for analytes/field parameters listed in Table 2-1 of the Work Plan.

Following injection, the ability of the ORC Advanced™ in creating conditions favorable for biodegradation of petroleum hydrocarbon compounds will be assed through the monitoring conducted to:

1. verify that the ORP and DO levels are increasing in the new well relative to pre-injection conditions.
2. verify that Fe(III) concentrations are increasing through the reduction in dissolved iron concentrations (as Fe (III) is insoluble relative to Fe(II)) relative to pre-injection conditions.
3. verify that manganese concentrations are increasing through the increase in dissolved manganese concentrations (as a result of oxidation from Mn (2+) to the insoluble Mn(4+)) relative to pre-injection conditions.
4. verify that arsenite concentrations are reducing through the reduction in dissolved arsenic concentrations (as a result of the conversion of arsenite to the more oxidized and insoluble form of arsenate) relative to pre-injection conditions.

Based on the data and MACTEC and Regenesis' experience with sites with similar geologic settings, it is expected that the oxygen releasing compound will begin releasing oxygen immediately upon introduction into the water column and to continue to release oxygen for a period of approximately 12 months.
Two years after the oxygen release compound has been injected, the Trust will conduct in situ direct-push technology (DPT) soil confirmation sampling within and outside of the footprint of the Building 231 and 228 RUs at the historic wall interface, considering the technical constraints of access due to the presence

of existing buildings or other structural constraints. Details regarding the confirmation sampling will be described in an appendix to the Construction Completion Report based on the results of post-construction groundwater monitoring that assesses the effectiveness of oxygen release compound injection in reducing petroleum-related COCs within the saturated zone.

Additional application of in-situ oxygen release compound via in-situ injection may be considered if results of groundwater monitoring and confirmation sampling indicate concentrations of COCs exceeds cleanup levels approximately 18 months after the oxygen releasing compound is applied. MACTEC will evaluate the effectiveness of the oxygen releasing compound and present the evaluation in a technical memorandum (as described in Section 5.0 of the Work Plan, Reporting and Corrective Action Documentation) that summarizes water quality data, and recommendations for further oxygen releasing compound application, if needed. The Trust will present data to stakeholders on the effectiveness of treatment as well as recommendation for further treatment (possible injection of additional oxygen releasing compound), if necessary.

# E-3.0 REFERENCES

Erler & Kalinowski, Inc. (EKI), 1999a. *Final Corrective Action Plan Building 637 Area, Presidio of San Francisco, California.* August.

_____, 1999b. *Corrective Action Plan Building 637 Area Work Plan, Presidio of San Francisco, California.* August.

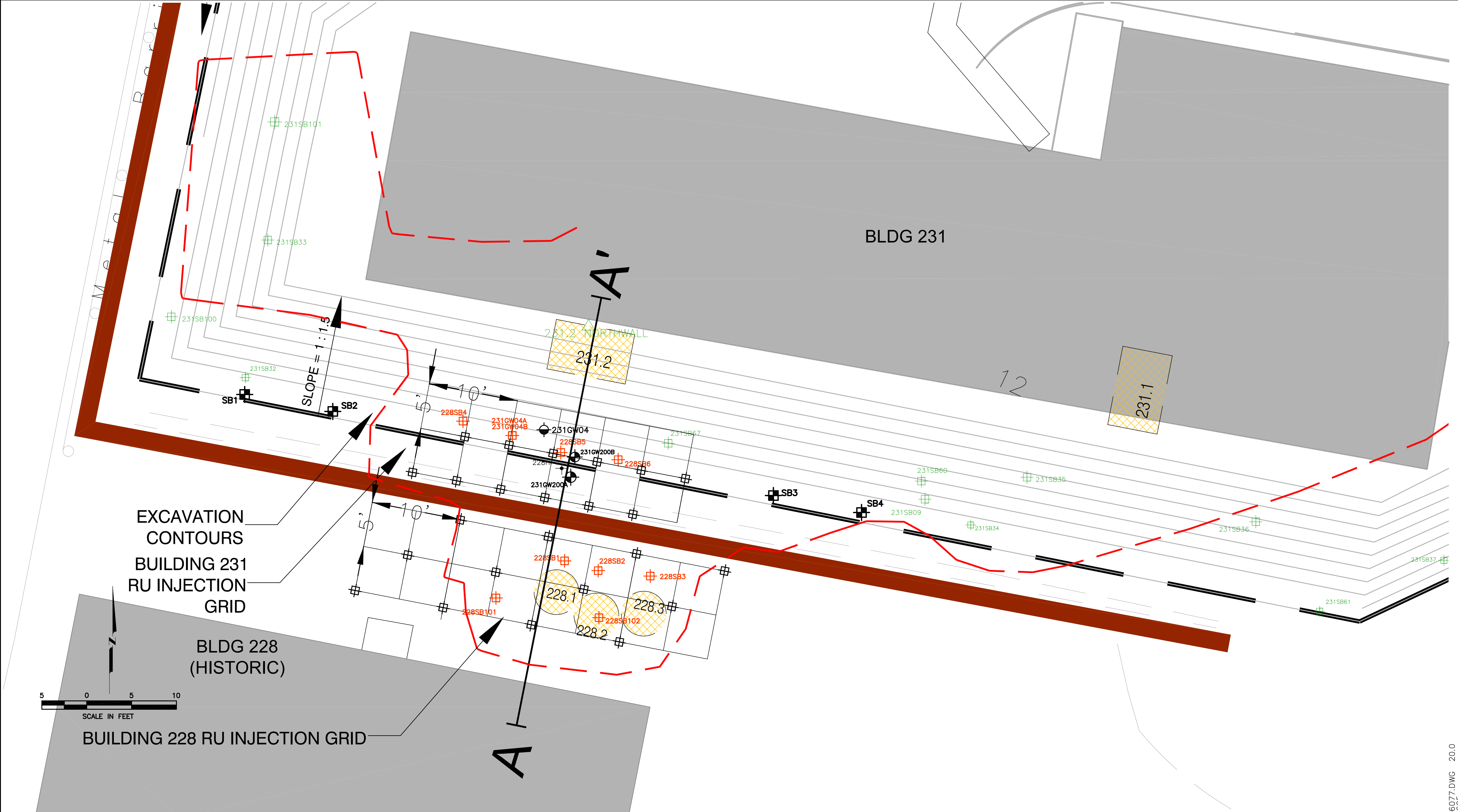
_____, 2000. *Excavation Report for the Building 637 Area, Presidio of San Francisco, California.* June 22.

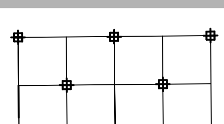
_____, 2004. *Completion Report for the Building 637 Area, Presidio of San Francisco, California.* March 31.

_____, 2008. *Monitoring Well Installation, Building 207/231 Area, Presidio of San Francisco, California.* April 23.

MACTEC, 2008. *Draft Work Plan, Groundwater Monitoring Well Installation, Building 207/231 Area, Presidio of San Francisco, California*. January 23.

FIGURES



INJECTION GRID: REPRESENTATIVE INJECTION GRID S FOR, SEQUENTIALLY:
**BUILDING 231 RU:** FOUR (4) REGENOX INJECTION EVENTS OVER A PERIOD OF APPROXIMATELY 6 WEEKS, WITH POINTS OFFSET AT EACH EVENT TO THE NORTHEAST BY 1.25 FEET, FOLLOWED BY ONE (1) ORC ADVANCED INJECTION EVENT. INJECTION POINTS EXTEND VERTICALLY FROM 1 TO 11 FEET BGS.
**BUILDING 228 RU:** ONE (1) ORC ADVANCED INJECTION EVENT CONCURRENTLY WITH BUILDING 231 RU ORC ADVANCED INJECTION EVENT. INJECTION POINTS EXTEND VERTICALLY FROM 6 TO 20 FEET BGS.

## LEGEND

- SB1 — PROPOSED SOIL BORING LOCATION
- 231GW200A — MONITORING WELL LOCATION
- ORC INJECTION POINT
- 228SB101 — SOIL BORING LOCATION WHERE COCS WILL NOT REMAIN AT CONCENTRATIONS EXCEEDING CLEANUP LEVELS FOLLOWING EXCAVATION
- 231GW04 — DECOMMISSIONED MONITORING WELL LOCATION
- 228HP1 — HYDROPUNCH LOCATION
- 228SB5 — SOIL BORING LOCATION WHERE CONTAMINATION WILL NOT BE REMOVED BY EXCAVATION
- EXCAVATION CONTOURS
- ASSUMED EXCAVATION AREA
- CROSS SECTION A - A' (SHOWN ON FIGURE E-3)
- 231.1, 231.2 FORMER UST'S REMOVED
  231.1 - 600 Gallon (Waste Oil)
  231.2 - 500 Gallon (Gasoline)
- INTERPRETATION OF THE EXTENT OF PETROLEUM CONTAMINATION AT THE BUILDING 231 AND BUILDING 228 RU INTERFACE
- FORMER UST'S REMOVED (APPROX DEPTH OF 5 FEET BGS)

MACTEC

OVERVIEW OF PROPOSED IN SITU REMEDIATION
INJECTION PLANS, HISTORIC WALL INTERFACE
BUILDING 207/231 AREAS
PRESIDIO OF SAN FRANCISCO
SAN FRANCISCO, CALIFORNIA

FIGURE: **E-1**

| DRAWN | JOB NUMBER | CHECKED | CHECKED DATE | APPROVED | APPROVED DATE |
|---|---|---|---|---|---|
| JHD | 4084075106 | JHD | 10/2008 | RR | 10/2008 |

4084075106077.DWG 20.0
20080711.1605

**LEGEND**

HISTORIC HIGH GROUNDWATER

EXCAVATION GRADE

EXISTING GRADE

POTENTIAL SLIDING SURFACE (FS=1.5)

ZONE OF PETROLEUM CONTAMINATION THAT WILL BE REMEDIATED IN-SITU.

ZONE OF PETROLEUM CONTAMINATION THAT WILL BE REMOVED BY EXCAVATION.

TYPICAL INJECTION POINT SEE NOTE 5 FOR DESCRIPTION

SOIL SAMPLE LOCATION

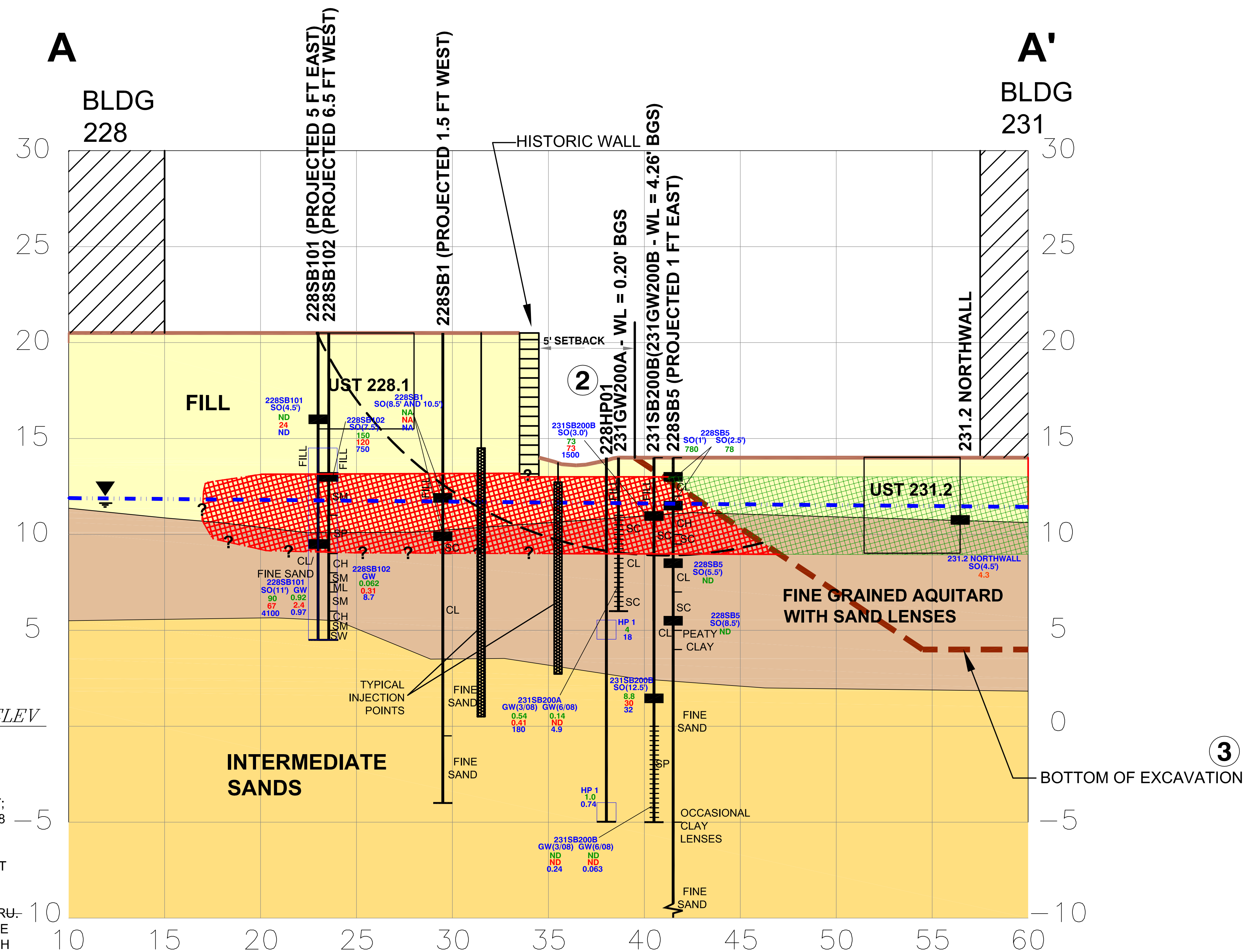
HYDROPUNCH SAMPLE POINT

WELL SCREEN INTERVAL

228SB101 SAMPLE STATION
SO(3.0') MATERIAL SAMPLED (DEPTH IN FEET BGS)
.062 TPH DIESEL
0.31 TPH FUEL OIL/MOTOR OIL
8.7 TPH GASOLINE
4.3 TPH UNKNOWN

ALL CONCENTRATIONS ARE IN mg/kg FOR SOIL AND mg/l FOR GROUNDWATER

SO = SOIL
GW = GROUNDWATER




0 5 10
SCALE IN FEET

**NOTE**

1. VERTICAL DATUM FOR THE CROSS-SECTIONS IS NAVD 88- US SURVEY FEET; ELEVATION MEASUREMENTS TAKEN IN PLLW WERE CONVERTED TO NAVD 88 TO BE CONSISTENT WITH TOPOGRAPHIC SURVEY DATA.
   CONVERSION: NAVD 88 = PLLW-0.37
2. BORING LOG FOR 228HP1 IS UNAVAILABLE; AS A RESULT, LITHOLOGY IS NOT SHOWN.
3. THE EXCAVATION BOTTOM IS LOCATED ONE FOOT BELOW THE DEEPEST SAMPLE CONTAINING COCS ABOVE SITE SPECIFIC CLEANUP LEVELS IN 231 RU.
4. THE HISTORIC HIGH GROUNDWATER CONTOUR WAS GENERATED FROM THE HIGHEST REPORTED GROUNDWATER ELEVATION DATA FROM 2001 THROUGH 2006 FOUND IN THE PRESIDIO SEMI ANNUAL GROUNDWATER MONITORING REPORT 1ST AND 2ND QUARTERS 2006 (TREADWELL AND ROLLO, OCTOBER 2006).
5. INJECTION POINTS: REPRESENTATIVE INJECTION POINTS FOR, SEQUENTIALLY: **BUILDING 231 RU:** FOUR (4) REGENOX INJECTION EVENTS OVER A PERIOD OF APPROXIMATELY 6 WEEKS, WITH POINTS OFFSET AT EACH EVENT TO THE NORTHEAST BY 1.25 FEET, FOLLOWED BY ONE (1) ORC ADVANCED INJECTION EVENT. INJECTION POINTS EXTEND VERTICALLY FROM 1 TO 11 FEET BGS. **BUILDING 228 RU:** ONE (1) ORC ADVANCED INJECTION EVENT CONCURRENTLY WITH BUILDING 231 RU ORC ADVANCED INJECTION EVENT. INJECTION POINTS EXTEND VERTICALLY FROM 6 TO 20 FEET BGS.

MACTEC

CROSS-SECTION OF PROPOSED IN SITU REMEDIATION INJECTION PLANS, HISTORIC WALL INTERFACE
BUILDING 207/231 AREA
PRESIDIO OF SAN FRANCISCO
SAN FRANCISCO, CALIFORNIA

FIGURE: **E-2**

| DRAWN | JOB NUMBER | CHECKED | CHECKED DATE | APPROVED | APPROVED DATE |
|---|---|---|---|---|---|
| JHD | 4084075106 | JHD | 10/2008 | RR | 10/2008 |

APPENDIX E

ATTACHMENTS

REVIEWED BY: RR

ATTACHMENT E-1

MONITORING WELL INSTALLATION REPORT, BUILDING 231/207 AREA
(TREADWELL & ROLLO, INC., APRIL, 2008)

REVIEWED BY: RR

23 April 2008
Project No. 2893.67

Mr. Ryan Seelbach
The Presidio Trust
34 Graham Street
P.O. Box 29052
San Francisco, CA 94129

Subject: Monitoring Well Installation
Building 231/207 Area
Presidio of San Francisco, California

Dear Mr. Seelbach:

Treadwell & Rollo, Inc. (Treadwell and Rollo) is pleased to submit this report documenting the installation of monitoring wells 231GW200A and 231GW200B at the Building 231/207 Area (Site) in the Presidio of San Francisco, California (Figure 1). The monitoring wells are located south of Building 231 and adjacent to a historic wall between Building 231 and Building 228 (Figure 1). Building 231 is located at the intersection of Halleck Street and Gorgas Avenue. We understand that the wells will be used to monitor the groundwater chemistry directly downgradient of the proposed ORC® injection points adjacent to Building 228 (Figure 1) as outlined in the *Revised Draft Implementation Work Plan* dated 2 November 2007 prepared by MACTEC Engineering and Consulting, Inc. The wells are positioned as close to the historic wall as possible to ensure that they will not be affected by a proposed remedial excavation at the Site. All work was performed in general accordance with the *Draft Work Plan, Groundwater Monitoring Well Installation, Building 207/231 Area, Presidio of San Francisco, California* dated 18 January 2008 prepared by MACTEC Engineering and Consulting, Inc. (Work Plan). The monitoring well installation activities performed at the Site are described below.

**Monitoring Well Installation**

On 28 January 2008, Treadwell & Rollo supervised the drilling of two soil borings (231SB200A and 231SB200B) using a track-mounted hollow-stem auger drill rig. These borings were subsequently converted into monitoring wells; one screened in the shallow groundwater zone (231GW200A) and one in the intermediate groundwater zone (231GW200B) at the Site. Prior to drilling, the soil borings were hand-augered to 5 feet below ground surface (bgs) to ensure that no underground utilities or footings from the historic wall were present. Soil samples were continuously collected using an 18-inch split-spoon sampler for lithologic description purposes during drilling. The sampler was driven 18-inches ahead of the augers at each sample point. A photoionization detector (PID) was used to field-screen the soil samples for volatile organic compounds (VOCs). Organic vapor readings are presented on the boring logs in Attachment A. Three soil samples (including one duplicate) were retained for chemical analyses. The materials encountered in the boring were logged according to the Unified Soil Classification System by a Treadwell & Rollo field geologist under the supervision of a California-registered geologist. All drilling activities were performed by Gregg Drilling and Testing, Inc. of Martinez, California. The boring logs and well construction diagrams are included in Attachment A.

Coarser grained fill material (silty sand with gravel [SM]) was encountered from surface to 3 feet bgs and below that depth, finer grained fill soil (sandy clay and clay with sand [CL]) was present to 9.5 feet bgs, where Bay Mud was encountered. The top of the first Bay Mud layer was observed at a depth of 9.5 feet bgs in boring 231SB200B. The initial drilling was conducted using 8-inch hollow-stem augers and was stopped once the Bay Mud was observed in the cores. The 8-inch augers were then removed and the borehole was re-drilled using 12-inch augers. A 10-inch diameter steel conductor casing was placed into the borehole and pushed into the Bay Mud confining layer to a depth of 10 feet bgs. Neat cement grout was placed around the conductor casing to seal off the upper groundwater zone and to prevent the mixing of groundwater between the upper and intermediate zones. The borehole was sealed at the surface for approximately 72 hours to allow the cement grout to set.

After the conductor casing had been installed into 231SB200B, the shallow boring (231SB200A) was advanced to 8 feet bgs using 8-inch hollow stem augers approximately 3 feet to the west of 231SB200B, adjacent to the historic retaining wall. Boring 231SB200A was converted to monitoring well 231GW200A. Monitoring well 231GW200A was constructed of 2-inch-diameter Schedule 40 PVC casing with flush threads and 0.010-inch-slot well screen. The well screen for well 231GW200A was installed from approximately 3 feet to 8 feet bgs. Blank well casing was installed from the top of the screen to the ground surface. A sand filter pack (No. 2/12 sand) was installed in the borehole annulus from the bottom to approximately 2.5 feet bgs. A 6-inch collar of fine silica sand was installed from 2 to 2.5 feet bgs. A 1-foot-thick seal of hydrated bentonite pellets was placed above the fine silica sand filter pack and the remainder of the borehole annulus was sealed with a neat cement grout. A locking water-tight well cap was placed on the well casing, and a traffic-rated well box was installed to protect the wellhead and to prevent water from entering the well. Well construction details are presented on the boring log (Attachment A).

On 1 February 2008, Treadwell and Rollo and Gregg Drilling personnel returned to the Site to complete the intermediate zone monitoring well construction (231GW200B). The drilling resumed by advancing the boring through the center of the conductor casing that had been previously installed. The boring was continuously cored using the split-spoon sampler and was extended to 19 feet bgs using 8-inch diameter augers. Lithologic conditions were recorded to ensure proper monitoring well construction. The monitoring well was constructed of 2-inch-diameter Schedule 40 PVC casing with flush threads and 0.010-inch-slot well screen. The well screen for well 231GW200B was installed from approximately 14 feet to 19 feet bgs. Blank well casing was installed from the top of the screen to the ground surface. A sand filter pack (No. 2/12 sand) was installed in the borehole annulus from the bottom to top of the well screen. A 2-foot-thick collar of fine silica sand was installed from 12 to 14 feet bgs. A 2-foot-thick seal of hydrated bentonite pellets was placed above the sand filter pack. The remainder of the borehole annulus was sealed with a neat cement grout. A locking water-tight well cap was placed on the well casing, and a traffic-rated wellbox was installed to protect the wellhead and to prevent water from entering the well. Well construction details are shown on the boring log (Attachment A).

On 6 February 2008, wells 231GW200A and 231GW200B were developed by Blaine Tech Services of San Jose, California using surge and pumping methods. After surging the well with a 2-inch surge block for approximately 15 minutes, the wells were purged using a positive air displacement pump. Water quality measurements including temperature, pH, conductivity, and turbidity were recorded at each casing volume removed. Well 231GW200A was dewatered twice during development. After dewatering, the pump was removed and the well was allowed to recharge. Following recharge the well was surged again for 10 minutes followed by additional pumping and water quality measurements resumed. Development of both wells was completed after 10 casing volumes had been removed and all water

quality parameters had reached stability. Monitoring well development field data is presented in Attachment B.

As required by the State of California, Division of Water Resources (DWR) forms were completed and submitted for both new monitoring wells (Attachment C).

On 15 February 2008, Chaudhary Inc., a California-licensed land surveyor, surveyed the location and elevation of the top of the casing for the newly installed monitoring wells. Controls used for the survey included North American Datum of 1927 California State Plan – Zone 3 – U.S. Survey Feet (horizontal) and Presidio lower low water (PLLW) datum (vertical). The survey coordinates and top of casing elevation will be added to the quarterly groundwater monitoring well network data presented in the next quarterly monitoring report. The top of casing elevations for 231GW200A and 231GW200B were 14.34 and 14.26 feet above PLLW, respectively.

**Laboratory Analysis**

Three soil samples from 231SB200B were retained for laboratory analysis; one from the upper fill layer (approximately 3 feet bgs) and two from the intermediate sand underlying the Bay Mud (at approximately 12.5 and 13 feet bgs). All of the soil samples were analyzed for the following: total petroleum hydrocarbons (TPH) quantified as diesel and fuel oil (TPHd and TPHfo) by EPA Method 8015M, TPH quantified as gasoline (TPHg) by EPA Method 8015M, BTEX/MTBE by EPA Method 8260, and polynuclear aromatic hydrocarbons (PAHs) by EPA Method 8270SIM. Following the laboratory analysis, data validation was conducted by DataVal Incorporated. The laboratory and data validation reports are included as Attachment D and E, respectively. Analytical results are presented in Table 1 and discussed below.

The sample collected at 3 feet bgs [231SB200B(3)] had detected concentrations of TPH, BTEX, and PAHs. TPHg, TPHd, and TPHfo were detected at concentrations of 1,500, 73, and 73 milligrams per kilogram (mg/kg), respectively. Total xylenes were detected at a concentration of 1,800 micrograms per kilogram (µg/kg). PAHs (naphthalene, phenanthrene, fluoranthene, pyrene, benzo(a)anthracene, chrysene, and benzo(b)fluoranthene) were also detected above laboratory limits in 231SB200B(3) at concentrations ranging from 7 to 15 µg/kg.

Soil samples 231SB200B(12.5) (collected at 12.5 feet bgs) and DUP020108 (collected immediately beneath 231SB200B(12.5) at 13 feet bgs) both had detected concentrations of TPHg, TPHd, and TPHfo. TPHg, TPHd, and TPHfo were detected at concentrations of 32, 8.8, and 30 mg/kg in 231GW200B(12.5), respectively. TPHg, TPHd, and TPHfo were detected at concentrations of 15, 4, and 22 mg/kg in DUP020108, respectively. Soil sample 231SB200B(12.5) also had concentrations of naphthalene, phenanthrene, fluoranthene, and pyrene detected ranging from 7.5 to 26 µg/kg. Pyrene was the only PAH detected in DUP020108. No other compounds were detected in the soil samples collected.

If you have any questions after reviewing this report, please call Joshua Graber at (415) 955-9040.

Sincerely yours,
TREADWELL & ROLLO, INC.

Joshua D. Graber, REA I
Senior Project Manager

Dorinda C. Shipman, PG, CHG
Principal

PROFESSIONAL GEOLOGIST
DORINDA SHIPMAN
NO. 215
CERTIFIED HYDROGEOLOGIST
STATE OF CALIFORNIA

28936702.JDG

<u>Enclosures</u>:

| | |
|---|---|
| Figure 1 | Monitoring Well Locations and ORC® Injection Points |
| Attachment A | Boring Logs and Well Construction Diagrams |
| Attachment B | Monitoring Well Development Data Sheets and Groundwater Level Measurement Log |
| Attachment C | Completed DWR Forms |
| Attachment D | Certified Analytical Laboratory Reports and Chain-of-Custody Records |
| Attachment E | Data Validation Summary Report |

# TABLES

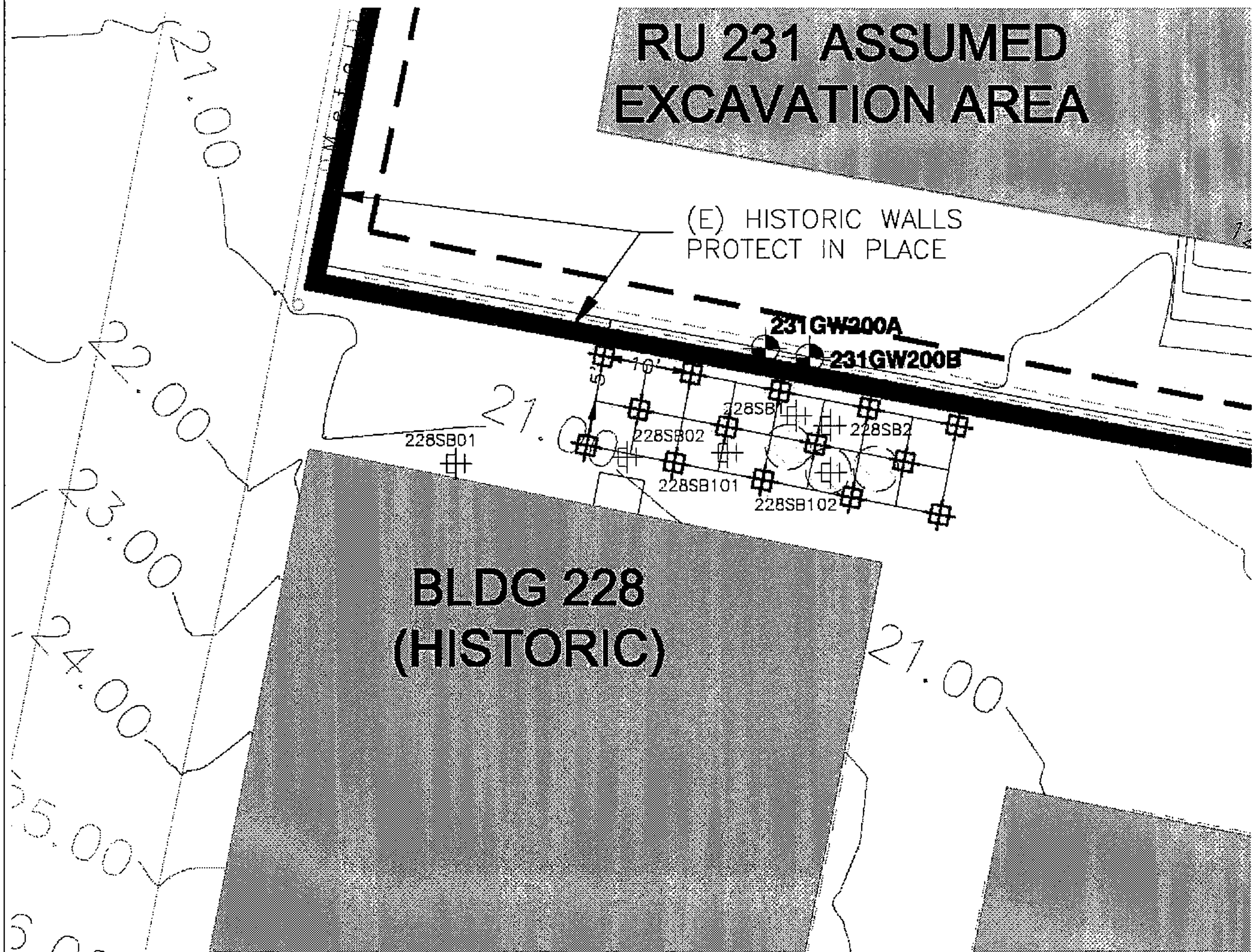
**Table 1**
**Soil Analytical Results**
**Building 231/207 Area Monitoring Well Installation**
**Presidio of San Francisco**
**San Francisco, California**

| | | | Petroleum Hydrocarbons | | | VOCs | | | | | PAHs | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sample ID** | **Depth** | **Date Sampled** | **TPHg** | **TPHd** | **TPHfo** | **Benzene** | **Toluene** | **Ethyl-benzene** | **Total Xylenes** | **MTBE** | **Naph-thalene** | **Phen-anthrene** | **Fluor-anthene** | **Pyrene** | **Benzo-(a)anthra-cene** | **Chrysene** | **Benzo-(b)fluor-anthene** | **All Other PAHs** |
| | **feet** | | **mg/kg** | | | **µg/kg** | | | | | | | | | | | | |
| 231SB200B(3) [1] | 3.0 | 01/28/08 | **1,500 (y)** | **73 (y)** | **73** | < 110 | < 180 | < 99 | **1,800 (J)** | < 150 | **13** | **14** | **15** | **14** | **7.0** | **7.0** | **7.7** | ND |
| 231SB200B(12.5) | 12.5 | 02/01/08 | **32 (y)** | **8.8 (y)** | **30** | < 6.4 | < 6.4 | < 6.4 | < 6.4 | < 6.4 | **9.0** | **7.5** | **7.9** | **26** | < 6.5 | < 6.5 | < 6.5 | ND |
| DUP020108 [2] | 13.0 | 02/01/08 | **15 (y)** | **4.0 (y)** | **22** | < 5.8 | < 5.8 | < 5.8 | < 5.8 | < 5.8 | < 6.2 | < 6.2 | < 6.2 | **7.9** | < 6.2 | < 6.2 | < 6.2 | ND |

Notes:
1 - The laboratory extract associated with EPA Method 8260B for soil sample 231SB200B(3) required a methanol extraction that resulted in elevated reporting limits of 1,000 µg/kg. The laboratory reported estimated results for m,p-xylenes and o-xylenes between the reporting limit and the method detection limit. Benzene, toluene, ethylbenzene, and MTBE were not detected above the method detection limit, therefore; the presented results are less than the laboratory's method detection limit for these compounds.
2 - Sample collected as Field Duplicate for 231SB200B(12.5)
feet - feet below ground surface
MTBE - Methyl Tertiary Butyl Ether
PAHs - Polynuclear aromatic hydrocarbons, EPA Method 8270SIM
TPHg - Total Petroleum Hydrocarbons as Gasoline, EPA Method 8015M
TPHd - Total Petroleum Hydrocarbons as Diesel Range (C10-C23), EPA Method 8015M
TPHfo -Total Petroleum Hydrocarbons as Motor Oil, EPA Method 8015M
VOCs - Volatile Organic Compounds
mg/kg - milligrams per kilogram
µg/kg - micrograms per kilogram
< 1,000 - Analyte was not detected above the laboratory reporting limit (1,000 mg/kg)
ND - Not detected at or above the laboratory reporting limit
(J) - Estimated value
(y) - Sample exhibits chromatographic pattern which does not resemble standard

Treadwell&Rollo

**FIGURES**




**EXPLANATION**

**231GW200A** Location of new monitoring well

ORC injection point

228SB101 Soil boring location

Former UST's removed (Approximate depth of 10 feet below ground surface)

Assumed excavation area

0 20 Feet

Approximate scale

Reference: Map from a drawing titled "Monitoring Well Locations and ORC Injection Points, by MACTEC, dated 01/15/08.

| | |
|---|---|
| **BUILDING 231/207 AREA**<br>**THE PRESIDIO**<br>San Francisco, California | **MONITORING WELL LOCATIONS**<br>**AND ORC INJECTION POINTS** |
| **Treadwell&Rollo** | Date 02/15/08 Project No. 2893.67 Figure 1 |

R:\Trgraphics\2800's\2850 - 2899\2893\2893.67\2893.67 Monitoring Well locations and ORC injection Points.dwg 4/11/08

Treadwell&Rollo

# ATTACHMENT A

## Boring Logs and Well Construction Diagrams

PROJECT: **BUILDING 231/207 AREA**
**THE PRESIDIO**
San Francisco, California

# Log of Monitoring Well 231SB200A

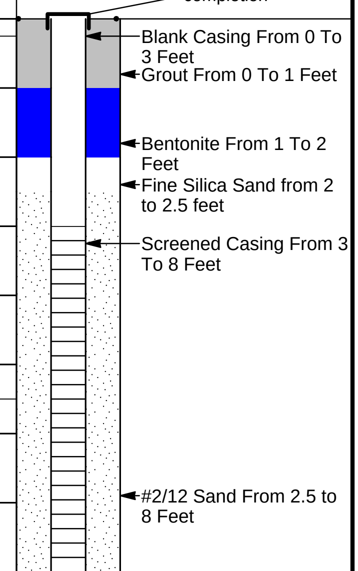


| | |
|---|---|
| Boring location: See Site Plan, Figure 1 | Logged by: C. Gordon<br>Drilled By: Gregg Drilling |
| Date started: 1/28/08 | Date finished: 1/28/08 |
| Drilling method: Hollow Stem Auger | |
| Hammer weight/drop: N/A | Hammer type: Auto |
| Sampler: Split Spoon | |

Top of Casing Elevation: 14.26[1]

| DEPTH (feet) | SAMPLES: Sample Number | Sample | Blow Count | Recovery (feet) | OVM (ppm) | LITHOLOGY | MATERIAL DESCRIPTION |
|---|---|---|---|---|---|---|---|
| 0–0.25 | | | | | | | 3-inches Asphalt Concrete (AC) |
| 0.25–3 | | | | | | SM | SILTY SAND with GRAVEL (SM) gray, wet, subangular, moderate odor (FILL) |
| 3–5.5 | | | | | | CL | SANDY CLAY (CL) gray, saturated, slightly plastic, strong odor, trace gravel |
| 5.5–7 | | | | | | CL | CLAY with SAND (CL) gray, medium stiff, wet, plastic, moderate odor |
| 7–8 | | | | | | CL | SANDY CLAY with GRAVEL (CL) gray, very soft, saturated, slightly plastic, moderate odor |

**WELL COMPLETION INFORMATION**




Boring terminated at a depth of 8 feet below ground surface.
Monitoring Well 231GW200A constructed in boring.
Groundwater encountered at a depth of 2.5 feet during drilling.

[1] Elevations based on Presidio Lower Low Water Datum

**Treadwell&Rollo**

Project No.: 2893.67 | Figure: A-1

LONG-LOG NAME-ENVIRO WELL LOG 289367.GPJ T&R.GDT 4/22/08

| PROJECT: | BUILDING 231/207 AREA<br>THE PRESIDIO<br>San Francisco, California | Log of Monitoring Well 231SB200B |
|---|---|---|



Boring location: See Site Plan, Figure 1

Date started: 2/1/08 | Date finished: 2/1/08

Drilling method: Hollow Stem Auger

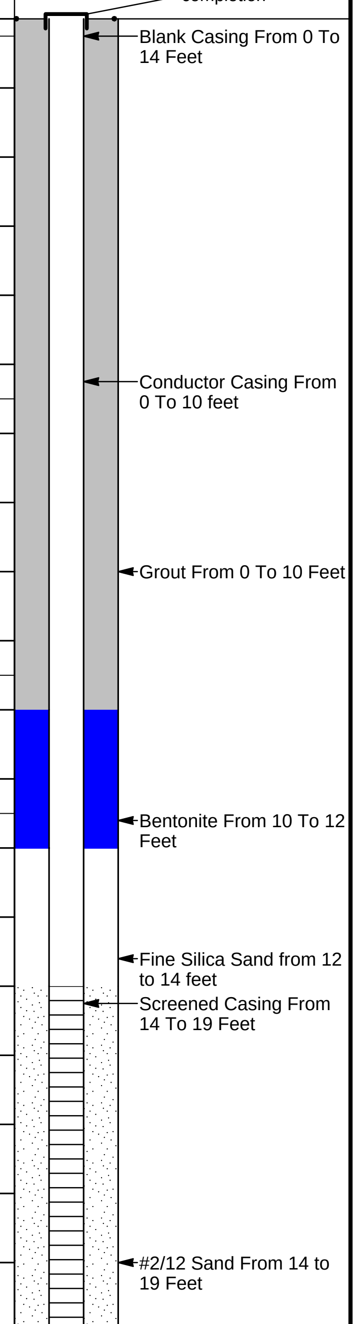
Hammer weight/drop: N/A | Hammer type: Auto

Sampler: Split Spoon

Logged by: C. Gordon
Drilled By: Gregg Drilling

| DEPTH (feet) | SAMPLES: Sample Number | Sample | Blow Count | Recovery (feet) | OVM (ppm) | LITHOLOGY | MATERIAL DESCRIPTION (Top of Casing Elevation: 14.34[1]) |
|---|---|---|---|---|---|---|---|
| 0 | | | | | | | 3-inches Asphalt Concrete (AC) |
| 0–3 | | | | | | SM | SILTY SAND with GRAVEL (SM)<br>gray, wet, subangular, moderate odor (FILL) |
| 3–5.5 | 231SB200B (3) | • | | | 100 | CL | SANDY CLAY (CL)<br>gray, soft, saturated, slightly plastic, strong odor, trace gravel |
| 5.5–9 | | | | | 25 | CL | CLAY with SAND (CL)<br>gray, medium stiff, wet, plastic, moderate odor |
| 9–9.5 | | | | | | CL | CLAY with SAND (CL)<br>gray, medium stiff, wet, plastic, moderate odor |
| 9.5–11.5 | | | | | | CL | CLAY (CL)<br>dark brown, soft, moist, plastic, moderate odor, organics in clay (BAY MUD) |
| 11.5–15 | 231SB200B (12.5)<br>DUP020108 | •<br>• | | | 5 | SP | SAND (SP)<br>olive-brown, loose, wet, weak odor |
| 15–19 | | | | | 0 | SP | SAND (SP)<br>light brown, loose, saturated, weak odor |

WELL COMPLETION INFORMATION




Boring terminated at a depth of 19 feet below ground surface.
Monitoring Well 231GW200B constructed in boring.
Conductor casing installed from ground surface to 10 feet below ground surface.
Groundwater encountered at a depth of 2.5 feet during drilling.

[1] Elevations based on Presidio Lower Low Water Datum

Treadwell&Rollo

Project No.: 2893.67 | Figure: A-2

## UNIFIED SOIL CLASSIFICATION SYSTEM

| Major Divisions | | Symbols | Typical Names |
|---|---|---|---|
| **Coarse-Grained Soils** (more than half of soil > no. 200 sieve size) | **Gravels** (More than half of coarse fraction > no. 4 sieve size) | **GW** | Well-graded gravels or gravel-sand mixtures, little or no fines |
| | | **GP** | Poorly-graded gravels or gravel-sand mixtures, little or no fines |
| | | **GM** | Silty gravels, gravel-sand-silt mixtures |
| | | **GC** | Clayey gravels, gravel-sand-clay mixtures |
| | **Sands** (More than half of coarse fraction < no. 4 sieve size) | **SW** | Well-graded sands or gravelly sands, little or no fines |
| | | **SP** | Poorly-graded sands or gravelly sands, little or no fines |
| | | **SM** | Silty sands, sand-silt mixtures |
| | | **SC** | Clayey sands, sand-clay mixtures |
| **Fine -Grained Soils** (more than half of soil < no. 200 sieve size) | **Silts and Clays** LL = < 50 | **ML** | Inorganic silts and clayey silts of low plasticity, sandy silts, gravelly silts |
| | | **CL** | Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, lean clays |
| | | **OL** | Organic silts and organic silt-clays of low plasticity |
| | **Silts and Clays** LL = > 50 | **MH** | Inorganic silts of high plasticity |
| | | **CH** | Inorganic clays of high plasticity, fat clays |
| | | **OH** | Organic silts and clays of high plasticity |
| **Highly Organic Soils** | | **PT** | Peat and other highly organic soils |

## GRAIN SIZE CHART

| Classification | Range of Grain Sizes: U.S. Standard Sieve Size | Range of Grain Sizes: Grain Size in Millimeters |
|---|---|---|
| Boulders | Above 12" | Above 305 |
| Cobbles | 12" to 3" | 305 to 76.2 |
| Gravel | 3" to No. 4 | 76.2 to 4.76 |
| coarse | 3" to 3/4" | 76.2 to 19.1 |
| fine | 3/4" to No. 4 | 19.1 to 4.76 |
| Sand | No. 4 to No. 200 | 4.76 to 0.075 |
| coarse | No. 4 to No. 10 | 4.76 to 2.00 |
| medium | No. 10 to No. 40 | 2.00 to 0.420 |
| fine | No. 40 to No. 200 | 0.420 to 0.075 |
| Silt and Clay | Below No. 200 | Below 0.075 |

▽ Unstabilized groundwater level

▼ Stabilized groundwater level

## SAMPLE DESIGNATIONS/SYMBOLS

Sample taken with Sprague & Henwood split-barrel sampler with a 3.0-inch outside diameter and a 2.43-inch inside diameter. Darkened area indicates soil recovered

Classification sample taken with Standard Penetration Test sampler

Undisturbed sample taken with thin-walled tube

Disturbed sample

Sampling attempted with no recovery

Core sample

Analytical laboratory sample

Sample taken with Direct Push sampler

## SAMPLER TYPE

| | |
|---|---|
| C | Core barrel |
| CA | California split-barrel sampler with 2.5-inch outside diameter and a 1.93-inch inside diameter |
| D&M | Dames & Moore piston sampler using 2.5-inch outside diameter, thin-walled tube |
| O | Osterberg piston sampler using 3.0-inch outside diameter, thin-walled Shelby tube |
| PT | Pitcher tube sampler using 3.0-inch outside diameter, thin-walled Shelby tube |
| S&H | Sprague & Henwood split-barrel sampler with a 3.0-inch outside diameter and a 2.43-inch inside diameter |
| SPT | Standard Penetration Test (SPT) split-barrel sampler with a 2.0-inch outside diameter and a 1.5-inch inside diameter |
| ST | Shelby Tube (3.0-inch outside diameter, thin-walled tube) advanced with hydraulic pressure |

ATTACHMENT E-2

REGENESIS LETTER PROPOSALS FOR HISTORIC WALL INTERFACE—BUILDING 228 RU (DECEMBER, 2004) AND BUILDING 231 (JULY, 2008) (INCLUDING PROJECT EVALUATION FORMS, AND SLURRY MIXING AND INJECTION APPLICATION INSTRUCTIONS)

REVIEWED BY: RR

**REGENESIS**

December 4, 2006 **Proposal No. 1JB07201**


Margaret Stemper
MACTEC
189 North Main Street
South Deerfield, MA 01373
E-mail: mlstemper@mactec.com


**Subject: Application of ORC *Advanced* (Advanced Formula Oxygen Release Compound) to Accelerate the Natural Attenuation of Contaminants of Concern (COCs) at the Presidio Building 228 Site in San Francisco, California**

Dear Ms. Stemper:

Thank you for your interest in Regenesis and our Advanced formula Oxygen Release Compound (ORC *Advanced*™) product. We have reviewed the information that you provided for the above-referenced site. In the following sections of this proposal, we will discuss: the use of ORC *Advanced*, design and cost information, delivery of ORC *Advanced* to the subsurface, a recommended groundwater monitoring program, and the performance goals for this particular project. In addition, this proposal should be considered preliminary because some assumptions were made regarding the current biogeochemical conditions of the aquifer and the extent of the contaminant plume requiring treatment. We look forward to working with you on developing a site-specific strategy that will help meet your objectives for the site.

## Use of Advanced formula Oxygen Release Compound (ORC *Advanced*™) to Accelerate Bioremediation

Advanced formula Oxygen Release Compound (ORC *Advanced*) is a patented formulation of phosphate-intercalated calcium oxyhydroxide that is a timed-released source of oxygen. ORC *Advanced* releases oxygen in the dissolved-phase when it is hydrated. Numerous studies have shown that the lack of oxygen can limit the ability of naturally occurring microorganisms (aerobes) to degrade certain compounds. ORC *Advanced* provides terminal electron acceptors to support the oxidative biodegradation of many types of aerobically degradable compounds including but not limited to: petroleum-based hydrocarbons (e.g. Toluene) and chlorinated hydrocarbons (e.g. Vinyl Chloride). ORC *Advanced* is manufactured as a fine powder that can be installed in the subsurface in the following ways: (1) mixed with water to form a slurry that can be injected into both the saturated and unsaturated zones, and (2) added as a soil amendment to the backfill material used in excavation applications. The use of oxygen sources such as ORC *Advanced* is recognized as a sensible strategy for engineering accelerated bioattenuation at project sites contaminated with aerobically degradable compounds.



**Checked** MS

Approved

**Preliminary Design and Cost Information for Full Scale Remediation**

Based on the provided data and our earlier conversations with you, Regenesis understands that the treatment approach at the subject site will consist of a barrier-based design approach upgradient of the historic wall north of building 228. This treatment strategy should significantly reduce the risk associated with the downgradient migration of COCs towards the historic wall and remediate the petroleum impacted soil upgradient of the historic wall. The design specifications for this treatment approach are found in a subsequent table.

**Data and Assumptions Used to Design this ORC *Advanced*™ Project**

The following data was used to determine the quantity of ORC *Advanced* needed for this site-specific project:

- Estimated plume area requiring treatment: The ORC *Advanced* barrier design presented is designed to significantly reduce contaminant migration north towards the historic wall and treat petroleum impacted soils extending north from building 228 to the historic wall.

- Representative contaminant concentration: [TPH] = 9.60 mg/L, [Toluene] = 0.0014 mg/L, [Ethylbenzene] = 0.085 mg/L, [Xylenes] = 0.094 mg/L

- Contaminated saturated zone thickness requiring treatment: 14 feet (6 to 20 feet bgs[1])

- Estimated groundwater velocity: up to 50.2 feet/year (**Please note that groundwater velocity controls the contaminant flux into the treatment zone. This flux should be considered when specifying ORC *Advanced* dosing requirements.)**

- Current groundwater geochemistry: assumed to be generally **[anaerobic]** with dissolved oxygen (DO) = 0.7 mg/L, nitrate = 0.05 mg/L, ferrous iron = 8 mg/L, and oxidation reduction potential (ORP) = Unknown mV

The design specifications and costs cited in the table below represent a preliminary design for an accelerated bioremediation project. The final design for this project may need to be adjusted as detailed design and regulatory oversight issues are finalized. For example, the following design variables may need to be adjusted prior to the implementation:

- Treatment areas may need to be increased or decreased depending on the overall site remediation strategy.
- The final delivery locations may need to be adjusted to account for site features such as underground utilities and other site structures.

***The Regenesis Technical Services Group is available to assist in the selection of an appropriate final design.***

---

[1]bgs = below ground surface

| ORC Advanced Barrier Treatment | |
|---|---|
| **Design Feature** | **Specification** |
| Saturated thickness requiring treatment | 14 feet |
| Treatment area | 40 foot long barrier |
| Delivery point spacing and configuration | 10 ft-on-center within rows, 5 ft between rows<br>3 rows of 4 points; 12 total points |
| ORC Advanced dose rate in lbs/vertical foot of injection | 6.1 lbs/foot, (85 lbs/point) |
| ORC Advanced material requirement | 12 pts. x 14 feet x 6.1 lbs/ft = 1,025 lbs |
| ORC Advanced material cost at $8.75/lb | $8,968.75 plus shipping and applicable sales tax |

## Total ORC *Advanced*™ Project Cost

The total cost of an ORC *Advanced*-accelerated bioremediation project can be estimated using the following items:

- ORC *Advanced*™ material, shipping fees, and sales tax
- Fieldwork costs associated with the installation of ORC *Advanced* (Customers are responsible for selecting the drilling subcontractor that will be used for the project.)
- Groundwater monitoring well construction (If additional monitoring wells are needed to properly monitor the performance of the project.)
- All fieldwork and laboratory analysis associated with periodic groundwater monitoring events
- Consultant oversight and report generation

The costs presented in this proposal are for ORC *Advanced* material costs for a one-time application only. The need to re-apply ORC *Advanced* depends on your plume management strategy, site-specific biodegradation performance, and the ultimate remediation goals for the site as well as other technical or regulatory considerations. For barrier-based designs, re-applications will be necessary every year as long as there is a need to prevent contaminant migration. As can be seen, project costs are directly related to the period of time needed to achieve the site-specific goals.

## ORC *Advanced*™ Delivery to Contaminated Zone

This product is normally applied to the subsurface using direct-push hydraulic equipment. Drive rods are pushed to the bottom of the contaminated saturated zone, and then ORC *Advanced* is injected as the rods are withdrawn. Drive rods with an inner diameter of at least 5/8 of an inch should be used to inject this material. At sites where direct-push is not feasible, auger-based equipment can be used to deliver ORC *Advanced* to the subsurface. Furthermore, where long-term treatment is required, permanent, small-diameter injection/re-injection wells may be the best application option.

If re-injection wells are used to apply ORC *Advanced*, the wells should be installed into regular boreholes with the annular space filled with aquarium gravel or an equivalent material. The permanent type injection wells should be constructed of Schedule 80 PVC pipe with wide screen slots (up to 0.04-inches). Generally, re-injection wells have diameters of one- to two-inches (25 to 50 mm) and are installed into six- to eight-inch (150 to 200 mm) boreholes. A thick (< three feet) bentonite seal should be installed at the top of the screened interval in order to minimize the possibility of short-circuiting during injection/installation activities.

For most projects, an ORC *Advanced* slurry mixture with a solids content of 20% to 40% by weight can be used. Typically, ORC *Advanced* slurries used during installation activities have a solids content of 30%, but this value may need to be adjusted in the field so that the required mass of ORC *Advanced* can be injected at each location. For example, less permeable soil types (e.g. clays) may require a higher ORC *Advanced* percentage solids content slurry since less volume can be injected per location. If re-injection wells are used, an ORC *Advanced* slurry with a solids content of 15% to 20% by weight should be used. The volume of water per injection location can be calculated from the following equation:

Volume of water (gallons/injection point): $$\frac{\text{ORC Advanced lbs/hole}}{(8.34\text{ lbs/gal water})(\%\text{ ORC Advanced solids})}\left[1-(\%\text{ ORC Advanced solids})\right]$$

**After the ORC *Advanced* slurry has been installed, we recommend using a "water chaser" to push the material out of the well and into the formation. The water chaser should have a volume of at least twice the ORC *Advanced* slurry that was just injected. It is critical that this task is completed because the ORC *Advanced* slurry can set-up and harden and render the re-injection well useless in the future.**

One of the most critical aspects of a successful installation is having a pump that can properly install the material in the subsurface. Most direct-push contractors are equipped with grout pumps capable of installation. Typically, the pumps used for these types of product applications should have a pumping rate of at least three gallons per minute and a pressure rating of at least 500 pounds per square inch (psi). Failing to specify and use the appropriate equipment for this type of product installation may increase field time and result in improper application of the material. If you have any questions about purchasing, renting, or specifying a pump for a project, please contact the Technical Service Group staff at Regenesis.

## Recommended Groundwater Monitoring Program for ORC *Advanced*™ Projects

In order to validate the effectiveness of natural attenuation processes (ORC *Advanced*-enhanced treatment), we recommend conducting groundwater monitoring at selected wells. Also, a baseline round of sampling should be performed to identify the aquifer conditions prior to the installation of this material. After ORC *Advanced* has been installed into the subsurface, groundwater samples can be collected on a bi-monthly or quarterly basis. Once the initial biodegradation and geochemical trends have been identified, the monitoring frequency can be changed to a semi-annual or annual program. The groundwater monitoring program should employ low flow groundwater sampling techniques and include the measurement of the following field/chemical parameters:

- All COCs
- Field redox parameters: oxidation-reduction potential (ORP), pH, dissolved oxygen (DO), dissolved manganese, and dissolved (ferrous) iron

- Biochemical Oxygen Demand ($BOD_{5\text{-day}}$) and Chemical Oxygen Demand (COD) at selected groundwater monitoring wells within treatment area

### Groundwater Monitoring Locations

The following table outlines the suggested locations and significance of monitoring wells used to monitor the progress of an ORC *Advanced* -based project.

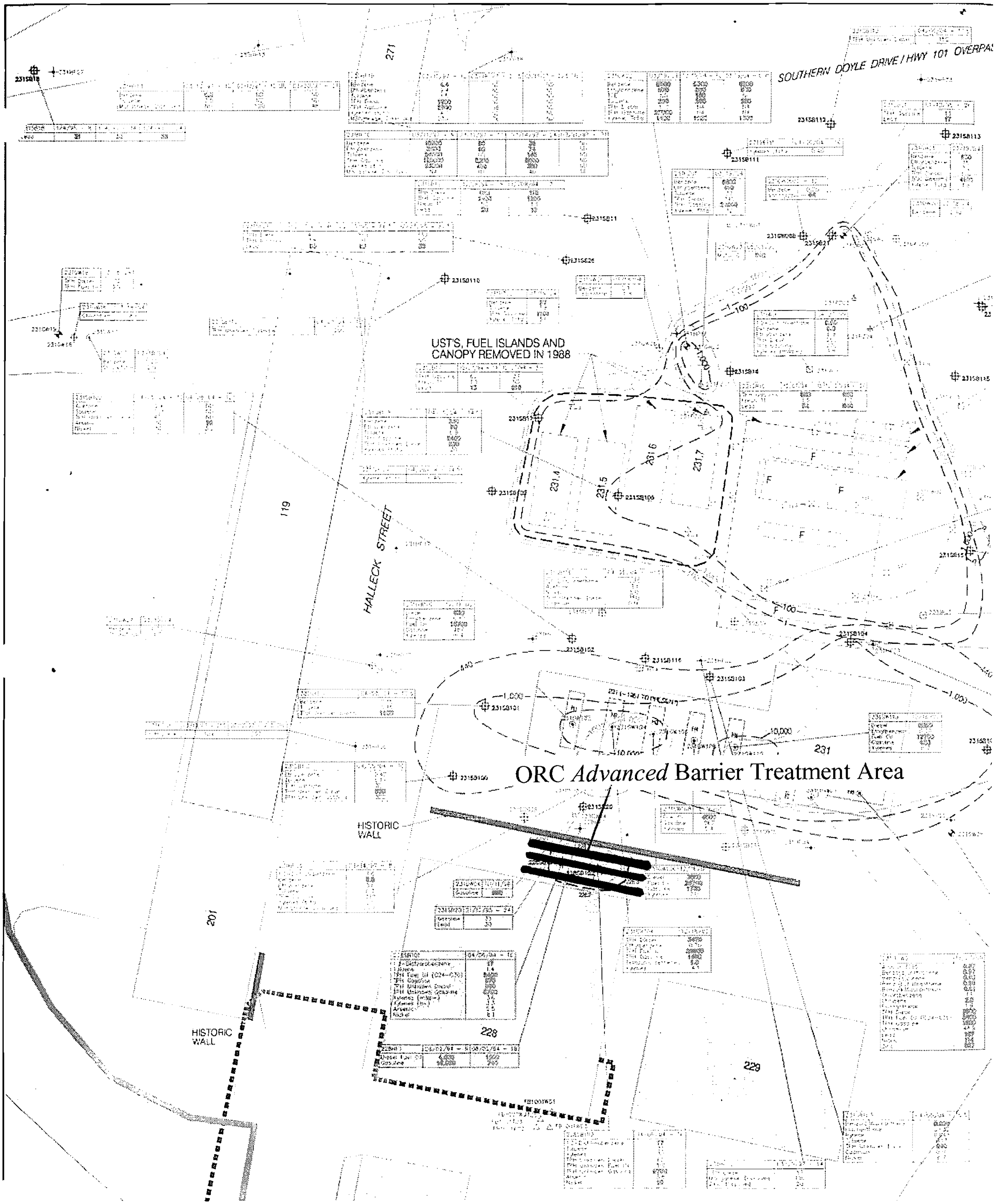
| Location | Significance |
|---|---|
| Background (Outside the groundwater plume) | Allows for the changes in natural attenuation conditions induced by addition of ORC *Advanced* to be compared to background levels |
| Upgradient of treatment zone | Provides a measure of contaminant and competing electron acceptor flux entering treatment zone |
| Inside treatment zone | Provides information on how ORC *Advanced* is affecting the aquifer conditions and contaminant concentrations |
| Downgradient of treatment zone | Provides information on the effect ORC *Advanced* is having on the biodegradation rates of contaminants and on aquifer conditions and confirms the mitigation migration |

Regenesis appreciates the opportunity to provide this information for your project. Please feel free to contact Jack Peabody, Regenesis' Western Regional Manager at (925) 944-5566 (e-mail at jpeabody@regenesis.com) or me at (949) 366-8000 x149 (e-mail at jbiondolillo@regenesis.com) any time to discuss this proposal.

Sincerely,

John Biondolillo

John Biondolillo
Manager of Technical Services – West Region




Treatment Area Diagram

| NO | DATE | REVISIONS | BY | CHK | DRAWN CN | PROJECT NO 4089041001 106 |
|---|---|---|---|---|---|---|
| | | | | | ENGINEER NAM | SCALE AS SHOWN |
| | | | | | CHECKED | APPROVED |
| | | | | | DATE | DATE |

MACTEC

# ORC *Advanced* Design Software for Barriers Using Slurry Injection

Aug 2006

Regenesis Technical Support: USA (949) 366-8000 www.regenesis.com

**Site Name:** Presidio Building 228 (San Francisco, CA)
**Location:** Barrier
**Consultant:** Margaret Stemper, MACTEC

**Estimated Plume Requiring Treatment**

| | | | | |
|---|---|---|---|---|
| Width of plume (intersecting gw flow direction) | 40 | ft | | |
| Depth to contaminated zone | 6 | ft | | |
| Thickness of contaminated saturated zone | 14 | ft | | |
| Nominal aquifer soil (gravel, sand, silty sand, silt, clay) | silty sand | | | |
| Effective porosity | 0.2 | | | |
| Hydraulic conductivity | 1.25 | ft/day | 4.4E-04 | cm/sec |
| Hydraulic gradient | 0.022 | ft/ft | | |
| Seepage velocity | 50.2 | ft/yr | 0.138 | ft/day |

| **Dissolved Phase Oxygen Demand:** | Contaminant Conc. | Contaminant Loading | Stoichiometry (wt/wt) | ORC-Adv Dose |
|---|---|---|---|---|
| Individual species that represent oxygen demand: | (mg/L) | (lb) | $O_2$/contam. | (lb) |
| Benzene | 0.00 | 0.00 | 3.1 | 0 |
| Toluene | 0.00 | 0.00 | 3.1 | 0 |
| Ethylbenzene | 0.09 | 0.03 | 3.2 | 1 |
| Xylenes | 0.09 | 0.03 | 3.2 | 1 |
| MTBE | 0.00 | 0.00 | 2.7 | 0 |
| cis-1,2-DCE | 0.00 | 0.00 | 0.7 | 0 |
| Vinyl Chloride | 0.00 | 0.00 | 1.3 | 0 |
| User added, add stoichiometric demand (see pull-down) | 0.00 | 0.00 | 0.0 | 0 |
| User added, add stoichiometric demand (see pull-down) | 0.00 | 0.00 | 0.0 | 0 |
| Reduced metals: $Fe^{+2}$ and $Mn^{+2}$ | 10.00 | 3.51 | 0.1 | 2 |
| | <- pull-down menu | | | |
| Measures of total oxygen demand | | | | |
| Total Petroleum Hydrocarbons | 9.60 | 3.37 | 3.1 | 62 |
| Biological Oxygen Demand (BOD) | 0.00 | 0.00 | 1.0 | 0 |
| Chemical Oxygen Demand (COD) | 0.00 | 0.00 | 1.0 | 0 |

**Length of time to evaluate contaminant flow into barrier:** 1 yr

| **Summary of Estimated ORC-Adv Requirement Measures** | Dissolved Phase ORC-Adv Demand (lbs) | Additional Demand Factor (1 to 10x) | Total ORC-Adv Demand (lbs) | ORC-Adv Cost | |
|---|---|---|---|---|---|
| Total BTEX, MTBE, etc. | 3 | 5.0 | 16 | $224 | |
| Total Petroleum Hydrocarbons | 62 | 16.3 | 1,000 | $8,969 | <- |
| Biological Oxygen Demand (BOD) | 0 | 2.0 | 0 | $0 | |
| Chemical Oxygen Demand (COD) | 0 | 1.5 | 0 | $0 | |

**Required ORC-Adv quantity (in 25 lb increments) ------------------------------->** **1,025** lbs ORC-Adv

**Delivery Design for ORC-Adv Slurry**

| | | |
|---|---|---|
| Spacing within rows (ft) | 10.0 | feet |
| Number of points per row | 4 | points/row |
| Number of rows | 3.0 | rows |
| Total number of points | 12 | points |
| ORC-Adv application rate | 6.1 | lbs/foot |
| Total ORC-Adv required | **1,025** | lbs of ORC-Adv |

**Slurry Mixing Volume for Injections**

| | | |
|---|---|---|
| Pounds per location | 85 | pounds |
| Buckets per location | 3.4 | buckets |
| Design solids content (20-40% by wt. for injections) | 30% | |
| Volume of water required per hole (gal) | 24 | gallons |
| Total water for mixing all holes (gal) | 287 | gallons |
| Simple ORC-Adv Backfilling: min hole diameter for 67% slurry | 4.1 | inches |
| Feasibility for slurry injection in sand: ok up to 15 lb/ft | (ok) | |
| Feasibility for slurry injection in silt: ok up to 10 lb/ft | (ok) | |
| Feasibility for slurry injection in clay: ok up to 10 lb/ft | (ok) | |

| **Project Summary** | | | |
|---|---|---|---|
| Number of ORC-Adv delivery points (adjust as necessary for site) | | | 12 |
| ORC-Adv application rate in lbs/ft (adjust as necessary for site) | | | 6.1 |
| ORC-Adv bulk material for slurry injection (lbs) | | | 1025 |
| Number of 25 lb ORC-Adv buckets | | | 41.0 |
| ORC-Adv bulk material cost ($/lb) | | $ | 8.75 |
| Cost for bulk ORC-Adv material | | $ | 8,969 |
| **Shipping and Tax Estimates in US Dollars** | | | |
| Sales Tax | rate: 0.00% | $ | - |
| Total Material Cost | | $ | 8,969 |
| Shipping (call for amount) | | $ | - |
| **Total Regenesis Material Cost** | | **$** | **8,969** |

| **ORC-Adv Slurry Injection Cost Estimate (responsibility of customer to contract work)** | | |
|---|---|---|
| Footage for each point = uncontaminated interval + ORC-Adv injection interval (f | | 20 |
| Total length for direct push for project (ft) | | 240 |
| Estimated daily installation rate (ft per day: 300 for push, 150 for drilling) | | 300 |
| Estimated points per day (10 to 30 is typical for direct push) | | 15.0 |
| Required number of days | | 1 |
| Mob/demob cost for injection subcontractor | $ | - |
| Daily rate for injection subcontractor ($1-2K for push, $3-4K for drill rig) | $ | - |
| Total injection subcontractor cost for application | $ | - |
| **Total Install Cost** (not including consultant, lab, etc.) | **$** | **8,969** |

| **Other Project Cost Estimates** | | |
|---|---|---|
| Design | $ | - |
| Permitting and reporting | $ | - |
| Construction management | $ | - |
| Groundwater monitoring and rpts | $ | - |
| Other | $ | - |
| Other | $ | - |
| Other | $ | - |
| Other | $ | - |
| **Total Project Cost** | **$** | **8,969** |

REGENESIS

## DIRECTIONS FOR ORC *Advanced*™ SLURRY MIXING

1. Open the 5-gallon bucket and remove the pre-measured bag of ORC *Advanced* (each bag contains 25 lbs of ORC *Advanced*).

2. Measure and pour water into the 5-gallon bucket according to the desired slurry consistency (a slurry calculation table is available on the Regenesis software in the Appendix tab):

| % Solids | Quantity of ORC *Advanced* (lbs) | Quantity of Water (gal) |
|---|---|---|
| 65 | 25 | 1.6 |
| 60 | 25 | 2.0 |
| 55 | 25 | 2.5 |
| 50 | 25 | 3.0 |
| 45 | 25 | 3.7 |
| 40 | 25 | 4.5 |
| 35 | 25 | 5.6 |
| 30 | 25 | 7.0 |
| 25 | 25 | 9.0 |
| 20 | 25 | 12.0 |

3. Add the corresponding quantity of water to the pre-measured quantity of ORC *Advanced*.

4. Use an appropriate mixing device to thoroughly mix the ORC *Advanced* and water together. A hand-held drill with a "jiffy mixer" or a stucco mixer on it may be used in conjunction with a small paddle to scrape the bottom and sides of the container. Standard environmental slurry mixers may also be used, following the equipment instructions for operation. For small quantities, the slurry can be mixed by hand if care is taken to blend all lumps into the mixture thoroughly.

**CAUTION**: **ORC *Advanced* may settle out of slurry if left standing.** ORC *Advanced* eventually hardens into a cement-like compound and cannot be re-mixed after that has occurred. Therefore, mix immediately before using to ensure that the mixture has not settled out. **Do not let stand more than 30 minutes.** If a mechanical slurry mixer attached to a pump is being used, the material may be cycled back through the mixer to maintain slurry suspension and consistency.

**1011 Calle Sombra · San Clemente, CA 92673 · tel: 949.366.8000 · fax: 949.366.8090**

**tech@regenesis.com · www.regenesis.com**

REGENESIS

# Oxygen Release Compound (ORC®)
# &
# Advanced Formula Oxygen Release Compound (ORC *Advanced*™)

# INSTALLATION INSTRUCTIONS

## SAFETY

Pure ORC and ORC *Advanced* are shipped as fine white and pale yellow powders, respectively. ORC is considered to be a mild oxidizer while ORC *Advanced* is considered an oxidizer therefore both products should be handled with care while in the field. Field personnel should take precautions while installing either the ORC or ORC *Advanced* product. Typically, the operator should work upwind of the products as well as use the appropriate personal protection equipment (PPE) which includes eye, respiratory protection, and gloves as deemed appropriate by exposure duration and field conditions. In addition, personnel operating the field equipment utilized during installation activities should have appropriate training, supervision and experience.

## GENERAL GUIDELINES

ORC/ORC *Advanced* can be installed in the contaminated saturated zone in the ground utilizing hand-augured holes, direct-push, hollow stem augers or air/mud-rotary drilling techniques. For optimum results, the ORC/ORC *Advanced* slurry should be installed across the entire vertical contaminated saturated thickness, including the capillary fringe and "smear zone."

Two general approaches are available for installation of these products. The first is to inject the ORC/ORC *Advanced* slurry through direct-push drive rods across the contaminated saturated zone and the second is to backfill the application points with the ORC/ORC *Advanced* slurry. Using the injection method should increase oxygen dispersion in the zone of interest over the life of the project because the ORC/ORC *Advanced* slurry affects a larger zone right from the start. If the backfill method is used more time may be required for the completion of the remediation process because oxygen distribution will be most likely be less.

It is important that the installation method and specific ORC/ORC *Advanced* slurry point location be established prior to field installation. It is also important that the ORC/ORC *Advanced* slurry volume and solids content for each drive point be pre-determined. The Regenesis Technical Services Group is available to discuss these issues. The Helpful Hints at the end of these instructions offers relevant information. Further information regarding ORC/ORC *Advanced* is available on the Regenesis website at www.regenesis.com.

## SPECIFIC INSTALLATION PROCEDURES

1. Identify the location of all underground structures, including utilities, tanks, and distribution piping, sewers, drains, and landscape irrigation systems.

2. Identify surface and aerial impediments.

3. Adjust planned installation locations for all impediments and obstacles.

4. Pre-mark the installation grid/barrier point locations, noting any that have special depth requirements.

5. Set up the unit over each specific point, following manufacturer recommended standard operating procedures (SOP).

**The section below contains instructions for augured-hole (hollow stem or air/mud rotary) applications. For direct-push applications, go to the following section.**

### <u>Instructions for Augured Hole Applications</u>

6. Hand augering and solid stem auger applications will generally require the soil matrix to stay open during auger removal. If this is the method being used, the ORC/ORC *Advanced* slurry should be installed immediately upon tool removal from the borehole.

7. Mix the appropriate quantity of ORC/ORC *Advanced* slurry for the current application point. Do not mix more slurry than will be used within a 30-minute period because the slurry could solidify and become useless.

8. Where soil conditions are unstable in the saturated zone, we recommend using a thicker ORC/ORC *Advanced* slurry. A solids content of 65-67% (consistency of toothpaste) is appropriate in these situations, since it comes relatively close to mimicking the density of soil.

9. **<u>Tremie pipe option #1</u>**: The slurry may be pumped through standard geotechnical slurry pumps and a tremie hose/pipe. We strongly recommend following the equipment manufacturer's standard operating instructions. Regenesis recommends that the tremie application be performed from the bottom of the hole up to the top of the capillary fringe. This is especially important if there is groundwater in the bottom of the installation hole, since it serves to maintain the densest portion of the ORC/ORC *Advanced* slurry mix.

10. **<u>Tremie pipe option #2</u>**: In relatively shallow situations, a tremie pipe may be used. Depending on the open hole diameter, a PVC tremie pipe with a one- to two-inch diameter may be used. The hole should be filled from the bottom of the hole to the top of the capillary fringe. It is normally a good idea, and may sometimes be a necessity, to use a "plunger" inside the tremie pipe to push the slurry through as the pipe is withdrawn. A funnel to pour slurry into the tremie pipe is advised.

11. **Hollow-stem auger option #1**: If the borehole being drilled would collapse during tool removal, augering applications require a hollow stem. By drilling with a plug in place, an open temporary source hole is created. The slurry may be installed with a tremie pipe or a tremie pump, following the pump manufacturer's operating instructions. Depending on the saturated zone soil conditions, it may be necessary to carefully coordinate the rate of auger withdrawal with the rate of slurry addition to preserve the hole void space for acceptance of the slurry.

12. **Hollow stem auger option #2 (auger as "tremie pipe")**: When soil conditions in the saturated zone are unstable and borehole collapse is likely, the hollow stem auger may be used as a tremie pipe. Prior to dropping the auger plug at the bottom of the hole, the ORC/ORC *Advanced* slurry is poured directly into the hollow stem, in a volume equal to the expected requirement for the hole. A plunger inside the auger is used to push the slurry down in the hole to keep it there as the auger is removed.

**Skip the next section and proceed to Step 13.**

**For Direct-Push Applications**

6. Push the drive rods (A 1.5-inch pre-probe can be used but is not recommended) with the detachable tip to the maximum desired depth. Standard drive rods (typically 1.25-inch O.D.) should be used. Pre-counted drive rods should be positioned prior to the installation driving procedure to assure the desired depth is reached.

7. Disconnect the drive rods from the implantable tip, following standard equipment procedures.

8. Mix the appropriate quantity of ORC/ORC *Advanced* slurry for the current injection point. Do not mix more slurry than will be used within a 30-minute period.

9. Set up and operate an appropriate slurry pump according to manufacturer's directions. Connect the pump to the probe puller/injector connector via a standard delivery hose. The hose is then attached to the drive rod with its quick disconnect fitting. Upon confirmation of all connections, add the ORC/ORC *Advanced* slurry to the pump hopper/tank.

10a. **Injection Application (if this is a backfill application, go to step 10b)**: While slowly withdrawing the drive rods, pump the pre-determined amount of ORC/ORC *Advanced* slurry into the aquifer. Typically, ORC/ORC *Advanced* injection rates are based on pounds of material installed per foot of vertical treatment. Observe pump pressure levels for indications of slurry dispersion and/or slurry refusal into aquifer (increasing pressure indicates reduced acceptance of material by the aquifer). As an optional pre-treatment step, pump one to two gallons of tap water into the aquifer to enhance dispersion pathways from the probe hole.

10b. **Backfill Application**: Pump the pre-determined quantity of ORC/ORC *Advanced* slurry into the borehole being treated. Observe pump pressure levels for indications of slurry dispersion

and/or slurry refusal into aquifer (increasing pressure indicates reduced acceptance of material by the aquifer).

11. Remove one four-foot section of the drive rod. If the drive rod contains slurry, return it to the ORC/ORC *Advanced* bucket/pump hopper for reuse.

12. Repeat steps 10 and 11 until treatment of the entire targeted thickness has been achieved. It is generally recommended that the procedure extend to the top of the capillary fringe/smear zone.

13. Place an appropriate seal, such as bentonite, above the ORC/ORC *Advanced* slurry through the entire vadose zone. This helps ensure that the slurry stays in place and prevents contaminants from migrating go the surface. Depending on soil conditions and local regulations, a bentonite seal can be pumped through the grout pump or added via chips or pellets after the drive rods have been removed.

14. Remove and decontaminate the drive rods and pre-probe (optional).

15. Finish the probe hole at surface as appropriate (concrete or asphalt cap, if necessary).

16. Move to the next injection point, repeating steps 5 through 15.

## HELPFUL HINTS

### *1) Physical characteristics*

The ORC/ORC *Advanced* slurry is made using the dry ORC/ORC *Advanced* powder makes a smooth slurry, the consistency of which depends on the amount of water used.

A 65-67% solids content ORC/ORC *Advanced* slurry (consistency of toothpaste) is thick but can still be pumped easily. This solids content slurry is normally used for back filling a borehole or probe hole. It is especially useful in situations where maximum density is desired, such as when ground water is present in the hole or when there are heaving sands.

As a rule, it is best to mix the first batch of slurry at the maximum solids content one would expect to use. The slurry can then be thinned by adding water in small increments. By monitoring this process, the appropriate quantities of water for subsequent batches can be determined.

The slurry should be mixed at about the time it is expected to be used. It is best not to hold it for longer than 30 minutes. Thinner slurries can experience separation if they stand too long. All solids content ORC/ORC *Advanced* slurries have a tendency to form a weak cement when left standing for extended periods or time. If a slurry begins to thicken too much, it should be mixed again and additional water should be added.

The ORC/ORC *Advanced* slurry should not be left sitting inside a grout pump or hose for extended periods because it will begin to set-up and harden. This problem can generally be avoided by re-circulating the slurry through the pump and hose back into the pump's hopper or mixing tank.

### 2) *Pump Equipment Cleaning and Maintenance*

Pumping equipment and drive rods can be lightly cleaned by circulating clear water through them. If necessary, further cleaning and decontamination should be performed according to the equipment supplier's standard procedures and local regulatory requirements.

### 3) *General Operating Procedures for Backfill Applications*

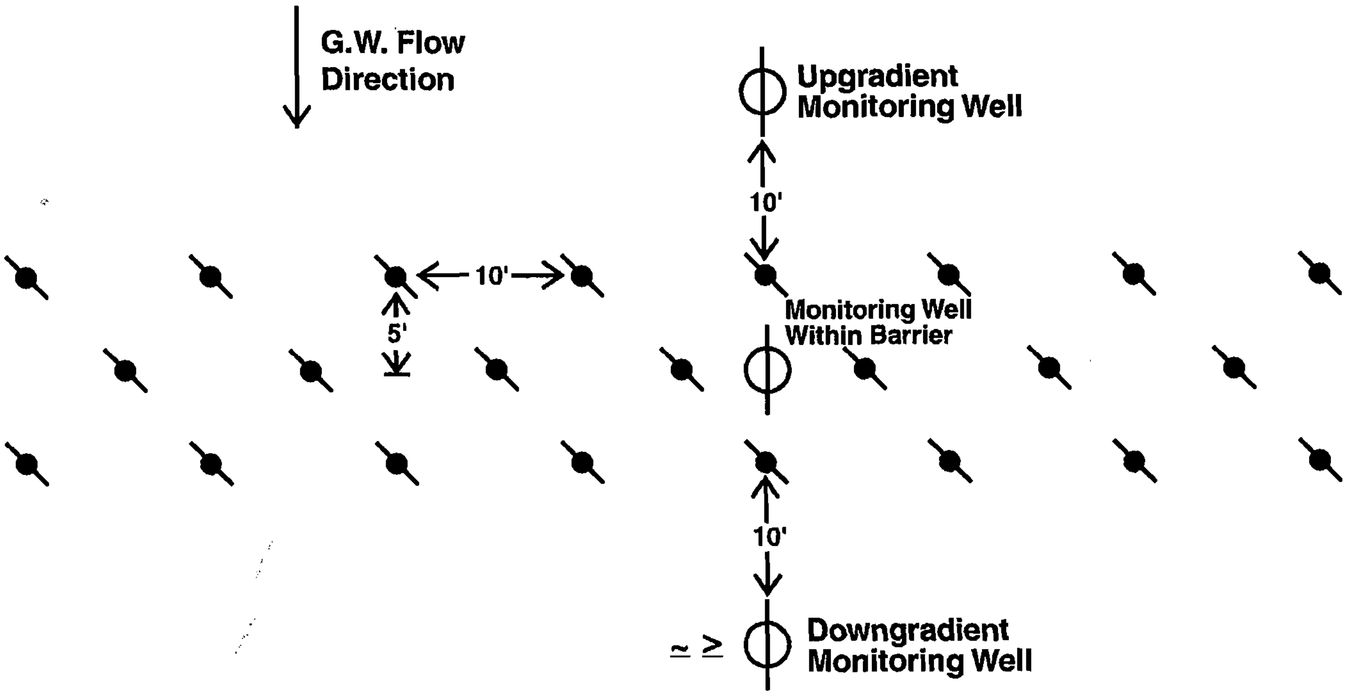
When performing a backfill installation, it is important to fill the appropriate portion of the hole with a thick (65-67% solids content) slurry that will solidify in place. Moderate amounts of pressure should be used to avoid fracturing the soil matrix or pumping slurry into the soil.

The operator should use care and monitor pumping pressures and quantities to ensure that the hole is being filled without pushing excess material into the soil matrix. Ideally, the rate of slurry pumping will be coordinated with the rate of drive rod withdrawal. It is usually important to install the slurry material to the top of the capillary fringe.

In addition, it is important that the entire contaminated saturated zone is treated (including the capillary fringe), as this is often the location of highest contaminant concentrations. Failure to properly treat this area can undermine an otherwise successful remediation effort.

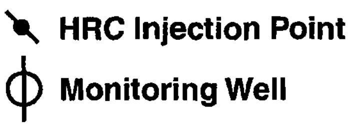
Ò **ORC is a registered trademark of Regenesis Bioremediation Products**

# TYPICAL INJECTION BARRIER LAYOUT




Continue point pattern over proposed length of barrier.

Legend



# PRICE SHEET

To order call: 949-366-8000
Fax: 949-366-8090

ORC® ADVANCED
OXYGEN RELEASE COMPOUND

REGENESIS
Advanced Technologies for Groundwater Resources

Effective Date: August 15, 2006

**Oxygen Release Compound Advanced (ORC Advanced®)** offers a low-cost, in situ approach to accelerating bioremediation at contaminated soil and groundwater sites. ORC Advanced is a unique calcium oxyhydroxide-based chemical formulation incorporating patented Controlled Release Technology (CRT™). When emplaced into the contaminated subsurface and hydrated, ORC Advanced releases 17% of its weight as oxygen at a controlled rate for periods of up to 12 months. This controlled release of oxygen cost-effectively stimulates naturally occurring microbes which rapidly degrade a wide range of aerobically degradable contaminants.

| **ORC Advanced Powder (Bulk Pricing)** | |
|---|---|
| **Quantity (lbs.)** | **Price/lb (US $)** |
| *50 – 999 | $8.95 |
| 1000-2499 | $8.75 |
| 2500-4999 | $8.50 |
| 5000-9999 | $8.25 |
| > 10,000 | Contact Regenesis |

NOTE: Bulk ORC Advanced Powder is shipped in five gallon PVC buckets weighing approximately 25 pounds each. Material Safety Data Sheet (MSDS) and Installation Instructions are included with each shipment.

**<u>*Minimum Order:</u>** 50 lbs. or $447.50

**<u>Terms & Conditions</u>:** Other Terms & Conditions are on reverse side.

**<u>Freight</u>** – All freight is FOB Regenesis Warehouse. Shipping warehouse will be determined by inventory levels and proximity to destination.

**<u>Payment Terms:</u>** Net 30 Days. Accounts outstanding after 30 days will be assessed 1.5% monthly interest. Accounts outstanding for purchase of ORC Advanced powder over 90 days will be re-invoiced at the undiscounted price of $8.95/lb.

**<u>Return Policy:</u>** A 15% re-stocking fee will be charged for all returned goods. Return freight must be prepaid. All requests to return product must be pre-approved by Regenesis. Returned product must be in original condition and no product will be accepted for return after a period of 90 days from time of delivery.

**<u>Remittance Address:</u>** Department 8873, Los Angeles, CA 90084-8873



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REGENESIS

# Oxygen Release Compound Advanced (ORC Advanced™)
# TERMS AND CONDITIONS

**1. CASUALTY AND AVAILABILITY OF RAW MATERIALS.** REGENESIS Bioremediation Products ("Seller") shall not be liable for delays in delivery or failure to manufacture or deliver due to causes beyond its reasonable control, including but not limited to acts of God, acts of buyer, acts of military or civil authorities, fires, strikes, flood, epidemic, war, riot, delays in transportation or car shortages, or inability to obtain necessary labor, materials, components or services through seller's usual and regular sources at usual and regular prices. In any such event seller may, without notice to buyer, at any time and from time to time, postpone the delivery dates under this contract or make partial delivery or cancel all or any portion of this and any other contract with buyer without further liability to buyer. Cancellation of any part of this order shall not affect seller's right to payment for any product delivered hereunder.

**2. LIMITED WARRANTY.** Seller warrants that the product sold hereunder is made with ORC Advanced as specified on face of invoice. Seller makes no other warranty of any kind respecting the product, and expressly DISCLAIMS ALL OTHER WARRANTIES OF WHATEVER KIND RESPECTING THE PRODUCT, INCLUDING ALL WARRANTIES OF MERCHANTABILITY AND FITNESS FOR PARTICULAR PURPOSE. BUYER'S SOLE REMEDY FOR BREACH OF THIS LIMITED WARRANTY SHALL BE REFUND OF THE PURCHASE PRICE, PROVIDED THAT ANY UNUSED PORTION OF THE PRODUCT IS PROMPTLY RETURNED TO SELLER. UNDER NO CIRCUMSTANCES WILL SELLER BE LIABLE FOR ANY CONSEQUENTIAL OR OTHER DAMAGES.

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**4. LIMITATION OF SELLER'S LIABILITY AND LIMITATION OF BUYER'S REMEDY.** Seller's liability on any claim of any kind, including negligence, for any loss or damage arising out of, connected with, or resulting from the manufacture, sale, delivery, resale, repair or use of any goods or services covered by or furnished hereunder, shall in no case exceed the lesser of the cost of repairing or replacing goods failing to conform to the forgoing warranty or the price of the goods or services or part thereof which gives rise to the claim. IN NO EVENT SHALL SELLER BE LIABLE FOR SPECIAL INCIDENTAL OR CONSEQUENTIAL DAMAGES, OR FOR DAMAGES IN THE NATURE OF PENALTIES.

**5. INDEMNIFICATION.** Buyer agrees to defend and indemnify seller of and from any and all claims or liabilities asserted against seller in connection with the manufacture, sale, delivery, resale or repair or use of any goods covered by or furnished hereunder arising in whole or in part out of or by reason of the failure of buyer, its agents, servants, employees or customers to follow instructions, warnings or recommendations furnished by seller in connection with such goods, by reason of the failure of buyer, its agents, servants, employees or customers to comply with all federal, state and local laws applicable to such goods, or the use thereof, including the Occupational Safety and Health Act of 1970, or by reason of the negligence of buyer, its agents, servants, employees or customers.

**6. EXPENSES OF ENFORCEMENT.** In the event Seller undertakes any action to collect amounts due from Buyer, or otherwise enforce its rights hereunder, Buyer agrees to pay and reimburse Seller for all such expenses, including, without limitation, all attorneys and collection fees.

**7. TAXES.** Liability for all taxes and import or export duties, imposed by any city, state, federal or other governmental authority, shall be assumed and paid by buyer. Buyer further agrees to defend and indemnify seller against any and all liabilities for such taxes or duties and legal fees or costs incurred by seller in connection therewith.

**8. ASSISTANCE AND ADVICE.** Upon request, seller in its discretion will furnish as an accommodation to buyer such technical advice or assistance as is available in reference to the goods. Seller assumes no obligation or liability for the advice or assistance given or results obtained, all such advice or assistance being given and accepted at buyer's risk.

**9. ENTIRE AGREEMENT.** This agreement constitutes the entire contract between buyer and seller relating to the goods or services identified herein. No modifications hereof shall be binding upon the seller unless in writing and signed by seller's duly authorized representative, and no modification shall be effected by seller's acknowledgment or acceptance of buyer's purchase order forms containing different provisions. Trade usage shall neither be applicable nor relevant to this agreement, nor be used in any manner whatsoever to explain, qualify or supplement any of the provisions hereof. No waiver by either party of default shall be deemed a waiver of any subsequent default.

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REGENESIS

July 10, 2008 **Proposal No. 3JB08686RII**

Margaret Stemper
MACTEC
600 Grand Avenue, Suite 300
Oakland, CA 94806
E-mail: mlstemper@mactec.com

**Subject: Site Remediation with RegenOx and ORC Advanced at the 207 and 231 Building Remediation Project Site in San Francisco, California: Preliminary Technical Review and Proposal - Revised**

Dear Ms. Stemper:

Thank you for your interest in Regenesis, and our state-of-the-art chemical oxidation product RegenOx™ and our Advanced formula Oxygen Release Compound product (ORC *Advanced*). We have reviewed the information you provided for the 207 and 231 Building Remediation Project site in San Francisco, California and developed a preliminary design and cost estimate for site treatment based on that information. We are also attaching, for your reference, general information on the delivery of RegenOx and ORC *Advanced* to the subsurface.

Please note this proposal includes material costs for a series of four RegenOx injection events all of which should be completed over the proposed treatment area within about a 6-week period (i.e., 2 weeks apart). We have also proposed an additional treatment with ORC *Advanced* after the chemical oxidation is complete, in order to ensure continued long-term destruction of the remaining contaminants on your site. As you may already be aware, RegenOx™ was specifically designed to facilitate a seamless transition to "polishing" with low-cost, passive *in-situ* bioremediation and it can be injected simultaneously with ORC *Advanced* on the final injection event to reduce application expenses.

## Total Material Cost

We recommend injection of a total of 5,040 lbs of RegenOx at the 207 and 231 Building Remediation Project site. The total cost for this amount of RegenOx is $11,088.00, plus applicable sales tax and shipping. Please see the attached RegenOx Summary Page for a detailed product breakdown per application event.

For the follow-up ORC *Advanced* treatment we are recommending that a total of 1,450 lbs of the product be applied. The total cost for this quantity of material is $12,687.50 plus applicable sales tax and shipping.

## Preliminary Design and Cost Details for RegenOx Applications

Based on the data provided and our conversation, we have provided the material cost associated with applying RegenOx throughout a 300 feet$^2$ area of the contaminated zone at the site and across a vertical thickness of 10 feet. The RegenOx material should be applied in a series of four injection events spaced

approximately 1-2 weeks apart. A total of 12 injection points spaced 5-ft on-center should be used for each event. To ensure the most effective distribution of the RegenOx material within the subsurface, the injection point locations should be offset (moved roughly 1.25 feet) from one injection event to the next.

## Performance Goals for RegenOx Projects

The primary goals for a chemical oxidation project are to (1) rapidly reduce the mass of contaminants in the subsurface and (2) to stabilize and/or reduce the size of the contaminant plume. Please note that after the injection of any chemical oxidant to a contaminated aquifer, dissolved-phase contamination will be reduced initially, but will then rebound somewhat in most cases, as the sorbed contaminants become redissolved. It is therefore critically important to accurately estimate the mass of soil-bound contaminant within the subsurface and to anticipate and allow for this predictable rebound in dissolved-phase contaminants after the initial injection. It is for this reason that Regenesis strongly recommends the use of a series of four RegenOx injections performed about 1-2 weeks apart, opposed to a single injection event.

As with any other remediation technology, chemical oxidation projects often reach asymptotic performance conditions. Therefore, a realistic set of goals should be established before the project is started. As proposed, in many cases a cost-effective treatment strategy includes the recommended series of RegenOx injections to rapidly reduce contaminant mass at the site, followed by application of a slow-release bioremediation amendment such as ORC *Advanced*. As noted earlier, this approach assures continued long-term treatment of remaining contaminants through low-cost bioremediation after the chemical oxidation treatment is complete.

## Preliminary Aquifer Volume Testing

Prior to application of the RegenOx material, it is highly recommended that a clear-water injection be performed at the site. The injection a non-reactive (clear-water) material at a volume that is approximately 30% greater than the anticipated application volume of RegenOx will provide good evidence of the aquifers capacity to accept the designed volume of RegenOx. Please note, the preliminary aquifer volume test should be conducted outside of the desired on-site treatment area(s) in order to avoid overloading the subsurface with clear-water before applying RegenOx on-site.

## ORC Advanced Application for Groundwater

The 300 feet$^2$ treatment area will require 1,450 pounds of ORC *Advanced* to be injected evenly into 12 points spaced 5 feet apart on-center. The injection can be concurrent with the final RegenOx injection to reduce injection costs or as the DO begins to drop to maximize the time period for aerobic degradation. The injected material should be placed from 1 to 11 feet bgs[1], i.e, within the saturated soil zone. Detailed calculations are provided on the attached ORC *Advanced* Design spreadsheet.

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[1] bgs = below ground surface

## ORC Advanced Performance Expectations

Regenesis' ORC *Advanced* is state-of-the-art technology for the controlled release of oxygen into contaminated groundwater and soils. The use of this product to successfully meet project objectives, however, is dependent upon a number of factors beyond the control of Regenesis. It is important that these factors be considered by those planning to use ORC *Advanced*. Failure to do so can result in unexpected or poor project results.

<u>Site Characterization</u>

This design/proposal is based upon site characteristics and professional opinions provided by MACTEC. It is the responsibility of MACTEC to ensure that the site characteristics provided to Regenesis and subsequently used in this design are representative of actual site characteristics. Actual site characteristics e.g. identification of the appropriate vertical treatment zone, that vary from those provided for this design may directly affect the overall performance of the project.

<u>Subsurface Product Delivery</u>

Product delivery during application is of the highest importance in ensuring project success. Attention must be given to both horizontal and vertical placement of the product. The professional judgment of MACTEC should be used to identify the appropriate treatment zone (vertical and lateral). The identified treatment zone should consider the distribution of the targeted contaminant as well as variations in subsurface permeability that might preferentially channel the product during application. Finally, it is the responsibility of MACTEC to ensure that the field delivery methods used by the applier actually deliver the product into the identified treatment zone.

<u>Project Responsibility</u>

Regenesis trusts that the present proposal is sufficiently complete. Given the nature and extent of project factors beyond the control of Regenesis, it must be understood that the responsibility for successful project implementation remains with MACTEC. However, as always, Regenesis would be pleased to assist with any technical support and product application advice we may be able to offer.

<u>Regenesis Support</u>

Regenesis is committed to supporting its customers with the highest level of service available in the remediation product industry. If you have any questions or require additional assistance with this design/proposal please contact us. If you are interested in a more comprehensive site data review and analysis or on-site application support services, Regenesis technical services staff is available to assist you on a fee basis. Please contact your Regenesis Technical Services professional for a fee schedule and project estimate.

Regenesis appreciates the opportunity to provide this information for your project. Please feel free to contact Jack Peabody, Western Region Manager at (925) 944-5566 (jpeabody@regenesis.com) or me at (949) 366-8000 x149 (jbiondolillo@regenesis.com) any time to discuss this proposal.

Sincerely,

John Biondolillo

John Biondolillo
Manager of Technical Services – West Region

Attachments:

- Application Instructions

**RegenOx Summary Page**

Regenesis Technical Support: USA (949) 366-8000

Aug 2006

**Site Name:** 207 & 231 Building Remediation Project (San Francisco, CA)
**Location:** Treatment Area
**Consultant:** Margaret Stemper, MACTEC

**Application Design Input Parameters**

| | | |
|---|---|---|
| Width of plume (intersecting gw flow direction) | 30 | ft |
| Length of plume (parallel to gw flow direction) | 10 | ft |
| Thickness of contaminated zone | 10 | ft |
| Soil type | clay | |

**Design Summary - INITIAL APPLICATION ONLY**

| | | |
|---|---|---|
| Number of RegenOx injection points (initial app) | 12 | pts |
| RegenOx dose rate (oxidant + activator) (initial app) | 12.0 | lbs/ft |
| Total amount of water required for initial application | 1,554 | gallons |
| Total volume of RegenOx solution applied per foot of injection (initial app) | 14.1 | gallons/ft |

| | |
|---|---|
| Estimated number of RegenOx applications required (enter 1 through 6) | 4 |

## Summary of Estimated RegenOx Totals

| Application number | Part A RegenOx Oxidant (lbs) | Part B RegenOx Activator (lbs) | Total RegenOx Material Requirement (lbs) | Cumulative Amount of Oxidant (Part A) Applied (lbs) | Cumulative Amount of Activator (Part B) Applied (lbs) | Cumulative RegenOx Cost | Total RegenOx Material Cost Per Application | Cost per cubic yard of soil treated ($/cubic yard) |
|---|---|---|---|---|---|---|---|---|
| First | 720 | 720 | 1,440 | 720 | 720 | $3,528 | $3,528.00 | $31.75 |
| Second | 720 | 720 | 1,440 | 1,440 | 1,440 | $7,056 | $3,528.00 | $31.75 |
| Third | 720 | 360 | 1,080 | 2,160 | 1,800 | $9,702 | $2,646.00 | $23.81 |
| Fourth | 720 | 360 | 1,080 | 2,880 | 2,160 | $12,348 | $2,646.00 | $23.81 |
| Fifth | 0 | 0 | 0 | 0 | 0 | $0 | $0.00 | $0.00 |
| Sixth | 0 | 0 | 0 | 0 | 0 | $0 | $0.00 | $0.00 |
| TOTALS | 2,880 | 2,160 | 5,040 | Volume discount if purchased all together | | | $11,088.00 | $99.79 |

**(not including shipping or applicable taxes)**

# ORC *Advanced* Design Software for Grid Applications Using Slurry Injection

Aug 2006

Regenesis Technical Support: USA (949) 366-8000 www.regenesis.com

**Site Name:** 207 & 231 Building Remediation Project (San Francisco, CA)
**Location:** Treatment Area
**Consultant:** Margaret Stemper, MACTEC

**Estimated Plume Requiring Treatment**

| | | | | | |
|---|---|---|---|---|---|
| Width of plume (intersecting gw flow direction) | 30 | ft | | | |
| Length of plume (parallel to gw flow direction) | 10 | ft | | 300 | $ft^2$ |
| Depth to contaminated zone | 1 | ft | | | |
| Thickness of contaminated saturated zone | 10 | ft | | | |
| Nominal aquifer soil (gravel, sand, silty sand, silt, clay) | clay | | | | |
| Total porosity | 0.45 | | Effective porosity: | 0.1 | |
| Hydraulic conductivity | 0 | ft/day | | 0.0E+00 | cm/sec |
| Hydraulic gradient | 0.022 | ft/ft | | | |
| Seepage velocity | 0.0 | ft/yr | | 0.000 | ft/day |
| Treatment Zone Pore Volume | 1,350 | $ft^3$ | | 10,099 | gallons |

| **Dissolved Phase Oxygen Demand:** | Contaminant Conc. | Contaminant Mass | Stoichiometry (wt/wt) | ORC-Adv Dose |
|---|---|---|---|---|
| Individual species that represent oxygen demand: | (mg/L) | (lb) | $O_2$/contaminant | (lb) |
| Benzene | 0.00 | 0.0 | 3.1 | 0 |
| Toluene | 0.00 | 0.0 | 3.1 | 0 |
| Ethylbenzene | 0.00 | 0.0 | 3.2 | 0 |
| Xylenes | 0.00 | 0.0 | 3.2 | 0 |
| MTBE | 0.00 | 0.0 | 2.7 | 0 |
| cis-1,2-DCE | 0.00 | 0.0 | 0.7 | 0 |
| Vinyl Chloride | 0.00 | 0.0 | 1.3 | 0 |
| TPH-g | 11.25 | 0.9 | 3.2 | 18 |
| TPH-d | 0.25 | 0.0 | 3.2 | 0 |
| Reduced metals: $Fe^{+2}$ and $Mn^{+2}$ | 9.80 | 0.8 | 0.1 | 0 |
| TPH-g | **<- pull-down menu** | | | |
| Measures of total oxygen demand | | | | |
| Total Petroleum Hydrocarbons (see pull-down for Koc) | 11.50 | 1.0 | 3.2 | 18 |
| Biological Oxygen Demand (BOD) | 0.00 | 0.0 | 1.0 | 0 |
| Chemical Oxygen Demand (COD) | 0.00 | 0.0 | 1.0 | 0 |

**Parameters for Sorbed Phase Oxygen Demand:**

| | | | | |
|---|---|---|---|---|
| Soil bulk density | 1.76 | $g/cm^3$ = | 110 | lb/cf |
| Fraction of organic carbon (foc) | 0.01 | range: 0.0001 to 0.01 | | |

| (Estimated using sorbed phase = foc*Koc*Cgw) | Koc | Contaminant Conc. | Contaminant Mass | Stoichiometry (wt/wt) | ORC-Adv Dose |
|---|---|---|---|---|---|
| (Adjust Koc as necessary to provide realistic estimates) | (L/kg) | (mg/kg) | (lb) | $O_2$/contaminant | (lb) |
| Benzene | 123 | 0.00 | 0.0 | 3.1 | 0 |
| Toluene | 267 | 0.00 | 0.0 | 3.1 | 0 |
| Ethylbenzene | 327 | 0.00 | 0.0 | 3.2 | 0 |
| Xylenes | 298 | 0.00 | 0.0 | 3.2 | 0 |
| MTBE | 12 | 0.00 | 0.0 | 2.7 | 0 |
| cis-1,2-DCE | 80 | 0.00 | 0.0 | 0.7 | 0 |
| Vinyl Chloride | 2.5 | 0.00 | 0.0 | 1.3 | 0 |
| TPH-g | 373.0 | 41.96 | 13.8 | 3.2 | 261 |
| TPH-d | 503.0 | 1.26 | 0.4 | 3.2 | 8 |
| Measures of total oxygen demand | | | | | |
| Total Petroleum Hydrocarbons | 373 | 152.25 | 50.2 | 3.2 | 947 |

| **Summary of Estimated ORC-Adv Requirements** | Dissolved Phase ORC-Adv Demand (lbs) | Sorbed Phase ORC-Adv Demand (lbs) | Additional Demand Factor (1 to 10x) | Total ORC-Adv Demand (lbs) | ORC-Adv Cost |
|---|---|---|---|---|---|
| Total BTEX, MTBE, etc. | 19 | 269 | 5.0 | 1,439 | $12,688 <- |
| Total Petroleum Hydrocarbons | 18 | 947 | 2.0 | 1,932 | $17,063 |
| Biological Oxygen Demand (BOD) | 0 | 0 | 2.0 | 0 | $0 |
| Chemical Oxygen Demand (COD) | 0 | 0 | 1.5 | 0 | $0 |

**Required ORC-Adv quantity (in 25 lb increments) ------------------------------>** **1,439** **pounds ORC-Adv**

**Delivery Design for ORC-Adv Slurry**

| | | |
|---|---|---|
| Spacing within rows (ft) | 5.0 | feet |
| # points per row | 6 | points/row |
| Spacing between rows (ft) | 5.0 | ft |
| # of rows | 2 | rows |
| Advective travel time bet. rows (days) | NA | days |
| Number of points in grid | 12 | points |
| ORC-Adv application rate | 12.0 | lbs/foot |
| Total ORC-Adv required | **1,439** | lbs of ORC-Adv |

**Slurry Mixing Volume for Injections**

| | | |
|---|---|---|
| Pounds per location | 120 | pounds |
| Buckets per location | 4.8 | buckets |
| Design solids content (20-40% by wt. for injections) | 40% | |
| Volume of water required per hole (gal) | 22 | gallons |
| Total water for mixing all holes (gal) | 261 | gallons |
| Simple ORC-Adv Backfilling: min hole dia. for 67% slurry | 5.7 | inches |
| Feasibility for slurry injection in sand: ok up to 15 lb/ft | (ok) | |
| Feasibility for slurry injection in silt: ok up to 10 lb/ft | (call Regenesis) | |
| Feasibility for slurry injection in clay: ok up to 10 lb/ft | (call Regenesis) | |

| **Project Summary** | | | |
|---|---|---|---|
| Number of ORC-Adv delivery points (adjust as necessary for site) | | | 12 |
| ORC-Adv application rate in lbs/ft (adjust as necessary for site) | | | 12.0 |
| ORC-Adv bulk material for slurry injection (lbs) | | | 1,450 |
| Number of 25 lb ORC-Adv buckets | | | 58.0 |
| ORC-Adv bulk material cost ($/lb) | | $ | 8.75 |
| Cost for bulk ORC-Adv material | | $ | 12,688 |
| **Shipping and Tax Estimates in US Dollars** | | | |
| Sales Tax | rate: 0.00% | $ | - |
| Total Material Cost | | $ | 12,688 |
| Shipping (call for amount) | | $ | - |
| **Total Regenesis Material Cost** | | **$** | **12,688** |

| **ORC-Adv Slurry Injection Cost Estimate (responsibility of customer to contract work)** | | |
|---|---|---|
| Footage for each point = uncontaminated interval + ORC-Adv injection interval (ft) | | 11 |
| Total length for direct push for project (ft) | | 132 |
| Estimated daily installation rate (ft per day: 300 for push, 150 for drilling) | | 300 |
| Estimated points per day (10 to 30 is typical for direct push) | | 27.3 |
| Required number of days | | 1 |
| Mob/demob cost for injection subcontractor | $ | - |
| Daily rate for injection subcontractor ($1-2K for push, $3-4K for drill rig) | $ | - |
| Total injection subcontractor cost for application | $ | - |
| **Total Install Cost** (not including consultant, lab, etc.) | **$** | **12,688** |

| **Other Project Cost Estimates** | | |
|---|---|---|
| Design | $ | - |
| Permitting and reporting | $ | - |
| Construction management | $ | - |
| Groundwater monitoring and rpts | $ | - |
| Other | $ | - |
| Other | $ | - |
| Other | $ | - |
| Other | $ | - |
| **Total Project Cost** | **$** | **12,688** |

REGENESIS
Advanced Technologies for Groundwater Resources

RegenOx™
CHEMICAL OXIDATION REDEFINED...

# INSTALLATION INSTRUCTIONS

## RegenOx Part A and Part B Mixing (basic)

### PERSONAL PROTECTIVE EQUIPMENT (PPE)

Personnel working with or in areas of potential contact with RegenOx should be required at a minimum to be fitted with modified Level D personal protective equipment:

- Eye protection – Wear goggles or a face shield
- Head – Hard hat when required
- Respiratory – Use dust respirator approved by NIOSH/MSA
- Hands – Wear neoprene gloves
- Feet – Wear steel toe shoes with chemical resistant soles or neoprene boots
- Clothing – Wear long sleeve shirts and long pant legs. Consider using a Tyvek® body suit, Carhartt® coverall or splash gear

See also Material Safety Data Sheets (MSDS) for RegenOx Part A and Part B for support in the development of a project-specific Health and Safety Plan (HSP).

### MATERIAL OVERVIEW, HANDLING, AND SAFETY

RegenOx is packaged in two parts. Part A is the RegenOx Oxidizer and Part B is the RegenOx Activator. Part A and Part B are shipped in separate 5-gallon buckets and each bucket has a gross weight of approximately 33 lbs (net weight of RegenOx is 30 lbs). The RegenOx Oxidizer is shipped as a fine white powder and the RegenOx Activator is shipped as a gel. The Activator has a viscosity roughly equivalent to cold honey. It is common for stored RegenOx Activator to settle somewhat in a container. Pre-heating the RegenOx Activator makes it easier to work with the material. A Material Safety Data Sheet for Part A (RegenOx Oxidizer) and for Part B (RegenOx Activator) is provided with each shipment. Personnel who operate field equipment during the installation process should have appropriate training, supervision, and experience.

# RegenOx™ Mixing


1. RegenOx™ is delivered on pallets.


2. RegenOx is in two parts:

Part A – the oxidizer
Part B – the activator

Each pail contains 30 lbs of RegenOx net.

Each pail weights approximately 33 lbs gross.

Quick Reference Solution Estimates
- Approximate 3% oxidant solution: 10 lbs of Part A oxidant mixed with 39 gallons of water.
- Approximate 4% oxidant solution: 10 lbs of Part A oxidant mixed with 29 gallons of water.
- Approximate 5% oxidant solution: 10 lbs of Part A oxidant mixed with 23 gallons of water.

3. Open a bucket of RegenOx Part B (activator - a greenish gel). Add about 1 gallon of water to the bucket, or approximately a 2" depth on the gel surface.

4. Thoroughly mix the water and RegenOx Part B until it is suspended in a silky mixture. Then leave it to one side while you prepare the RegenOx Part A.

5. Open a bucket of RegenOx Part A (oxidizer - a white powder). Pour it into approximately 69 to 117 gal. of water (if a large enough container is not available, mix it pro rata to the volume available).

6. Thoroughly mix the RegenOx Part A and water until the powder is dissolved (some may remain suspended). This may require 5 to 10 minutes of mixing.


7. <u>When you are ready to inject / apply the Regenox</u>, add the 'silky' Part B to the Part A.


8. Thoroughly mix the combined RegenOx Part A and RegenOx Part B until the mixture is even and any remaining Part A solids are dissolved.

A rusty colored solution should result, as shown.

9. The mixed RegenOx can now be directly applied to the contaminated zones.
Where contamination is shallow…RegenOx can be applied by hand, sprayed-on with a pump and hose, or applied and blended into the impacted treatment zone with excavation equipment.

Where contamination is deep…RegenOx can be applied using direct-push equipment and a suitable pump.

REGENESIS

RegenOx

CHEMICAL OXIDATION REDEFINED

**RegenOx™ *In Situ* Chemical Oxidation Application Instructions**

# Using Direct-Push Injection (Step-by-Step Procedures)

RegenOx™ is the new generation of chemical oxidation. RegenOx™ is a proprietary (patent-applied-for) *in situ* chemical oxidation process using a solid oxidant complex (sodium percarbonate/catalytic formulation) and an activator complex (a composition of ferrous salt embedded in a micro-scale catalyst gel). RegenOx™ with its catalytic system has very high activity, capable of treating a very broad range of soil and groundwater contaminants including both petroleum hydrocarbons and chlorinated solvents.

## Instructions

1) Prior to the installation of RegenOx™, any surface or overhead impediments should be identified as well as the location of all underground structures. Underground structures include but are not limited to utility lines; tanks; distribution piping; sewers; drains; and landscape irrigation systems. The planned installation locations should be adjusted to account for all impediments and obstacles. These considerations should be part of the SSHP or HASP.

2) Pre-mark the installation locations, noting any points that may have different vertical application requirements or total depth.

3) Set up the direct push unit over each point and follow the manufacturer standard operating procedures (SOP) for the direct push equipment. Care should be taken to assure that probe holes remain in the vertical.

4) For most applications, Regenesis suggests using 1.5-inch O.D./0.625-inch I.D drive rods. However, some applications may require the use of 2.125-inch O.D./1.5-inch I.D. or larger drive rods.

5) Advance drive rods through the surface pavement, as necessary, following SOP.

6) Push the drive rod assembly with an expendable tip to the desired maximum depth. Regenesis suggests pre-counting the number of drive rods needed to reach depth prior to starting injection activities.

7) After the drive rods have been pushed to the desired depth, the rod assembly should be withdrawn three to six inches. Then the expendable tip can be dropped from the drive rods, following SOP. If an injection tool was used instead of an expendable tip, the application of material can take place without any preliminary withdrawal of the rods.

8) In some cases, introduction of a large column of air prior to RegenOx™ application may be problematic because the air can block water flow to the treatment area. This is particularly the case in deep injections (>50 ft) with large diameter rods (>1.5-inch O.D.). To prevent the injection of air into the aquifer during RegenOx™ application, as well as to prevent problems associated with heaving sands, fill the drive rods with water, or the RegenOx™ mixture prior dropping the expendable tip or exposing the injection tool.

9) The RegenOx™ percent of the oxidizer in solution should range between 3% to 5%. Although solutions up to 8% may be used, this will likely increase the difficulty of injection due to reactivity. Solutions with greater than 8% oxidizer in solution will result in excess reaction and flocculation prior to injection and are not typically recommended

Measure the appropriate quantity of RegenOx™ Oxidizer for one to four vertical foot of injection into a 55 gallon drum or mixing tank. The volume of water per injection location can be calculated from the following formula:

$$\frac{\text{RegenOx Oxidizer lbs/foot}}{(8.34\ \text{lbs/gal water})(\%\ \text{R}egenOx\_Oxidizer\ \text{solids})}\left[1-(\%\ \text{R}egenOx\_Oxidizer\ \text{solids})\right]$$

Tighter formations (clays and silts), and even some fine sand formations will likely require higher oxidant percentages since less volume can be injected per location. The following are guides to various RegenOx™ mixing ratios based on the above equation.

- to make a roughly 3% oxidant solution for every 10 lbs of oxidant and 10 lbs of activator (20 lbs total RegenOx™), use 38 gallons of water.
- to make a roughly 4% oxidant solution for every 10 lbs of oxidant and 10 lbs of activator (20 lbs total RegenOx™), use 28 gallons of water.
- to make a roughly 5% oxidant solution for every 10 lbs of oxidant and 10 lbs of activator (20 lbs total RegenOx™), use 22 gallons of water.

10) Pour the pre-measured quantity of RegenOx™ Oxidizer into the pre-measured volume of water to make the desired target % oxidant in solution. NOTE: always pour the Oxidizer into water, do not pour water into the Oxidizer. Mix the water and oxidant with a power drill and paint stirrer or other mechanical mixing device to ensure that the Oxidizer has dissolved in the water.

11) Pour the applicable quantity of the pre-mixed RegenOx™ Activator into the oxidant:water solution. Mix the Oxidant and Activator using a power drill paint stirrer or other mechanical mixing device for at least 5 minutes until a homogenous mixture is formed. After mixing the RegenOx™ mixture should be injected into the subsurface as soon as possible.

12) Do not mix more RegenOx™ material than will be used over roughly 1 to 4 feet of injection so as to minimize potential above ground reaction/flocculation prior to injection.

    Transfer the contents of the mixing tank to the pump using gravity feed or appropriate transfer pump. (See Section 9.2: Pump Selection) For some types of pumps, it may be desirable to perform a volume check prior to injecting RegenOx™

13) Connect the delivery hose to the pump outlet and the delivery sub-assembly. Circulate RegenOx™ though the hose and the delivery sub-assembly to displace air in the hose. NOTE: an appropriately sized pressure gauge should be placed between the pump outlet and the delivery sub-assembly in order to monitor application pump pressure and detect changes in aquifer backpressures during application.

14) Connect the sub-assembly to the drive rod. After confirming that all of the connections are secure, pump the RegenOx™ through the delivery system to displace the water/fluid in the rods.

15) Slowly withdraw the drive rods. Commonly RegenOx™ injection progress at 1-foot intervals. However, continuous injection while slowly withdrawing single lengths of drive rod (3 or 4 feet) is an acceptable option. The pre-determined volume of RegenOx™ should be pumped into the aquifer across the desired treatment interval.

16) Remove one section of the drive rod. The drive rod may contain some residual RegenOx™. Place the RegenOx™-filled rod in a clean, empty bucket and allow the RegenOx to drain. Eventually, the RegenOx™ should be returned to the RegenOx™ pump hopper for reuse.

17) Monitor for any indications of aquifer refusal. This is typically indicated by a spike in pressure as indicated or (in the case of shallow applications) RegenOx™ "surfacing" around the injection rods or previously installed injection points. At times backpressure caused by reaction off-gassing will impede the pumps delivery volume. This can be corrected by bleeding the pressure off using a pressure relief/bypass valve (placed inline between the pump discharge and the delivery sub-assembly) and then resume pumping. If aquifer acceptance appears to be low, as indicated by high back pressure, allow sufficient time for the aquifer to equilibrate prior to removing the drive rod.

18) Repeat steps 13 through 23 until treatment of the entire contaminated vertical zone has been achieved. It is recommended that the procedure extend to the top of the capillary fringe/smear zone, or to the top of the targeted treatment interval.

19) Install an appropriate seal, such as bentonite, above the RegenOx™ material through the entire vadose zone. Prior to emplacing the borehole seal, we recommend placing clean sand in the hole to the top of the RegenOx™ treatment zone (especially important in holes that stay open). Bentonite chips or granular bentonite should be placed immediately above the treatment zone, followed by a cement/bentonite grout to roughly 0.5 feet below ground surface. Quick-set concrete should then be used as a surface seal.

20) Remove and clean the drive rods as necessary.

21) Finish the borehole at the surface as appropriate (concrete or asphalt cap, as needed). We recommend a quick set concrete to provide a good surface seal with minimal set up time.

22) A proper borehole and surface seal assures that the RegenOx™ remains properly placed and prevents contaminant migration from the subsurface. Each borehole should be sealed immediately following RegenOx™ application to minimize RegenOx™ surfacing during the injection process. If RegenOx™ continues to "surface" up the direct push borehole, an appropriately sized (oversized) disposable drive tip or wood plug/stake can be used to plug the hole until the aquifer pressures equilibrates and the RegenOx™ stops surfacing. If wells are used for RegenOx™ injection the RegenOx™ injection wells and all nearby groundwater monitoring wells should be tightly capped to reduce potential for surfacing through nearby wells.

23) Periodically compare the pre- and post-injection volumes of RegenOx™ in the holding tank or pump hopper using the pre-marked volume levels. Volume level may not be present on all tanks or pump hoppers. In this case, volume level markings can be temporarily added using known amounts of water and a carpenter's grease pencil (Kiel crayon).

24) Move to the next probe point, repeating steps 8 through 29. We recommend that the next RegenOx™ injection point be as far a distance as possible within the treatment zone from the previous RegenOx™ injection point. This will further minimize RegenOx™ surfacing and short circuiting up an adjacent borehole. When possible, due to the high volumes of liquid being injected, working from the outside of the injection area towards the center will limit expansion of the plume.

## Pump Selection

Regenesis has evaluated a number of pumps and many are capable of delivering RegenOx™ to the subsurface at a sufficient pressure and volumetric rate. However, even though a number of the evaluated pumps may be capable of delivering the RegenOx™ to the subsurface based on adequate pressures and delivery rates, each pump has its own set of practical issues that may make it more or less difficult to manage in a field setting.

In general, Regenesis strongly recommends using a pump with a pressure rating of 200 pounds per square inch (psi) in sandy soil settings, and 800 psi in silt, clay or weathered bedrock settings. Any pump under consideration should have a minimum delivery rate of 5 gallons per minute (gpm). A lower gpm rated pump may be used; however, they are not recommended due to the amount of time required to inject the volume of liquids typically associated with a RegenOx™ injection (i.e. 1,000 lbs of RegenOx™ [500 lbs Oxidant/500 lbs Activator] require roughly 1,100 gallons of water to make a 5% Oxidant solution).

Quite often diaphragm pumps are used for the delivery of chemical oxidants. Generally, these pumps operate pressures from 50-150 psi. Some of these pumps do not have the pressure head necessary to overcome the back pressure encountered in silt and clay lenses. In these cases the chemical oxidant thus ends up being delivered to the surrounding sands (the path of least resistance) and is not delivered to soil with residual adsorbed contamination. The use of a positive displacement pump such as a piston pump or a progressing cavity pump is may be superior because these pumps have the pressure necessary to overcome the resistance of low permeability soils. NOTE: be aware that application at pressures that are too high may over-consolidate the soil and minimize the direct contact of the oxidant. The key is to inject at a rate and pressure that maximizes the radius of influence without causing preferential flow. This can be achieved by injecting at the minimum pressure necessary to overcome the particular pressures associated with your site soil conditions.

Whether direct injection or wells are used, it is best to start by injecting RegenOx™ outside the contaminated area and spiral laterally inwards toward the source. Similarly, RegenOx™ should be applied starting vertically at the bottom elevation of contamination, through the layer of contamination, and a couple of feet above the layer of contamination. The reagents can be pushed out from the well bore with some water.

## Pump Cleaning

For best results, flush all moving parts and hoses with clean water at the end of the day; flush the injection system with a mixture of water and biodegradable cleaner such as Simple Green.

**For more information or technical assistance please call Regenesis at 949-366-8000**

REGENESIS

## DIRECTIONS FOR ORC *Advanced*™ SLURRY MIXING

1. Open the 5-gallon bucket and remove the pre-measured bag of ORC *Advanced* (each bag contains 25 lbs of ORC *Advanced*).

2. Measure and pour water into the 5-gallon bucket according to the desired slurry consistency (a slurry calculation table is available on the Regenesis software in the Appendix tab):

| % Solids | Quantity of ORC *Advanced* (lbs) | Quantity of Water (gal) |
|---|---|---|
| 65 | 25 | 1.6 |
| 60 | 25 | 2.0 |
| 55 | 25 | 2.5 |
| 50 | 25 | 3.0 |
| 45 | 25 | 3.7 |
| 40 | 25 | 4.5 |
| 35 | 25 | 5.6 |
| 30 | 25 | 7.0 |
| 25 | 25 | 9.0 |
| 20 | 25 | 12.0 |

3. Add the corresponding quantity of water to the pre-measured quantity of ORC *Advanced*.

4. Use an appropriate mixing device to thoroughly mix the ORC *Advanced* and water together. A hand-held drill with a "jiffy mixer" or a stucco mixer on it may be used in conjunction with a small paddle to scrape the bottom and sides of the container. Standard environmental slurry mixers may also be used, following the equipment instructions for operation. For small quantities, the slurry can be mixed by hand if care is taken to blend all lumps into the mixture thoroughly.

**CAUTION**: **ORC *Advanced* may settle out of slurry if left standing.** ORC *Advanced* eventually hardens into a cement-like compound and cannot be re-mixed after that has occurred. Therefore, mix immediately before using to ensure that the mixture has not settled out. **Do not let stand more than 30 minutes.** If a mechanical slurry mixer attached to a pump is being used, the material may be cycled back through the mixer to maintain slurry suspension and consistency.

**1011 Calle Sombra · San Clemente, CA 92673 · tel: 949.366.8000 · fax: 949.366.8090**

**tech@regenesis.com · www.regenesis.com**

# Oxygen Release Compound (ORC®)
# &
# Advanced Formula Oxygen Release Compound (ORC *Advanced*™)

## INSTALLATION INSTRUCTIONS

### SAFETY

Pure ORC and ORC *Advanced* are shipped as fine white and pale yellow powders, respectively. ORC is considered to be a mild oxidizer while ORC *Advanced* is considered an oxidizer therefore both products should be handled with care while in the field. Field personnel should take precautions while installing either the ORC or ORC *Advanced* product. Typically, the operator should work upwind of the products as well as use the appropriate personal protection equipment (PPE) which includes eye, respiratory protection, and gloves as deemed appropriate by exposure duration and field conditions. In addition, personnel operating the field equipment utilized during installation activities should have appropriate training, supervision and experience.

### GENERAL GUIDELINES

ORC/ORC *Advanced* can be installed in the contaminated saturated zone in the ground utilizing hand-augured holes, direct-push, hollow stem augers or air/mud-rotary drilling techniques. For optimum results, the ORC/ORC *Advanced* slurry should be installed across the entire vertical contaminated saturated thickness, including the capillary fringe and "smear zone."

Two general approaches are available for installation of these products. The first is to inject the ORC/ORC *Advanced* slurry through direct-push drive rods across the contaminated saturated zone and the second is to backfill the application points with the ORC/ORC *Advanced* slurry. Using the injection method should increase oxygen dispersion in the zone of interest over the life of the project because the ORC/ORC *Advanced* slurry affects a larger zone right from the start. If the backfill method is used more time may be required for the completion of the remediation process because oxygen distribution will be most likely be less.

It is important that the installation method and specific ORC/ORC *Advanced* slurry point location be established prior to field installation. It is also important that the ORC/ORC *Advanced* slurry volume and solids content for each drive point be pre-determined. The Regenesis Technical Services Group is available to discuss these issues. The Helpful Hints at the end of these instructions offers relevant information. Further information regarding ORC/ORC *Advanced* is available on the Regenesis website at www.regenesis.com.

## SPECIFIC INSTALLATION PROCEDURES

1. Identify the location of all underground structures, including utilities, tanks, and distribution piping, sewers, drains, and landscape irrigation systems.

2. Identify surface and aerial impediments.

3. Adjust planned installation locations for all impediments and obstacles.

4. Pre-mark the installation grid/barrier point locations, noting any that have special depth requirements.

5. Set up the unit over each specific point, following manufacturer recommended standard operating procedures (SOP).

**The section below contains instructions for augured-hole (hollow stem or air/mud rotary) applications. For direct-push applications, go to the following section.**

### <u>Instructions for Augured Hole Applications</u>

6. Hand augering and solid stem auger applications will generally require the soil matrix to stay open during auger removal. If this is the method being used, the ORC/ORC *Advanced* slurry should be installed immediately upon tool removal from the borehole.

7. Mix the appropriate quantity of ORC/ORC *Advanced* slurry for the current application point. Do not mix more slurry than will be used within a 30-minute period because the slurry could solidify and become useless.

8. Where soil conditions are unstable in the saturated zone, we recommend using a thicker ORC/ORC *Advanced* slurry. A solids content of 65-67% (consistency of toothpaste) is appropriate in these situations, since it comes relatively close to mimicking the density of soil.

9. **<u>Tremie pipe option #1</u>**: The slurry may be pumped through standard geotechnical slurry pumps and a tremie hose/pipe. We strongly recommend following the equipment manufacturer's standard operating instructions. Regenesis recommends that the tremie application be performed from the bottom of the hole up to the top of the capillary fringe. This is especially important if there is groundwater in the bottom of the installation hole, since it serves to maintain the densest portion of the ORC/ORC *Advanced* slurry mix.

10. **<u>Tremie pipe option #2</u>**: In relatively shallow situations, a tremie pipe may be used. Depending on the open hole diameter, a PVC tremie pipe with a one- to two-inch diameter may be used. The hole should be filled from the bottom of the hole to the top of the capillary fringe. It is normally a good idea, and may sometimes be a necessity, to use a "plunger" inside the tremie pipe to push the slurry through as the pipe is withdrawn. A funnel to pour slurry into the tremie pipe is advised.

11. **<u>Hollow-stem auger option #1</u>**: If the borehole being drilled would collapse during tool removal, augering applications require a hollow stem. By drilling with a plug in place, an open temporary source hole is created. The slurry may be installed with a tremie pipe or a tremie pump, following the pump manufacturer's operating instructions. Depending on the saturated zone soil conditions, it may be necessary to carefully coordinate the rate of auger withdrawal with the rate of slurry addition to preserve the hole void space for acceptance of the slurry.

12. **<u>Hollow stem auger option #2 (auger as "tremie pipe")</u>**: When soil conditions in the saturated zone are unstable and borehole collapse is likely, the hollow stem auger may be used as a tremie pipe. Prior to dropping the auger plug at the bottom of the hole, the ORC/ORC *Advanced* slurry is poured directly into the hollow stem, in a volume equal to the expected requirement for the hole. A plunger inside the auger is used to push the slurry down in the hole to keep it there as the auger is removed.

**Skip the next section and proceed to Step 13.**

## <u>For Direct-Push Applications</u>

6. Push the drive rods (A 1.5-inch pre-probe can be used but is not recommended) with the detachable tip to the maximum desired depth. Standard drive rods (typically 1.25-inch O.D.) should be used. Pre-counted drive rods should be positioned prior to the installation driving procedure to assure the desired depth is reached.

7. Disconnect the drive rods from the implantable tip, following standard equipment procedures.

8. Mix the appropriate quantity of ORC/ORC *Advanced* slurry for the current injection point. Do not mix more slurry than will be used within a 30-minute period.

9. Set up and operate an appropriate slurry pump according to manufacturer's directions. Connect the pump to the probe puller/injector connector via a standard delivery hose. The hose is then attached to the drive rod with its quick disconnect fitting. Upon confirmation of all connections, add the ORC/ORC *Advanced* slurry to the pump hopper/tank.

10a. **<u>Injection Application (if this is a backfill application, go to step 10b)</u>**: While slowly withdrawing the drive rods, pump the pre-determined amount of ORC/ORC *Advanced* slurry into the aquifer. Typically, ORC/ORC *Advanced* injection rates are based on pounds of material installed per foot of vertical treatment. Observe pump pressure levels for indications of slurry dispersion and/or slurry refusal into aquifer (increasing pressure indicates reduced acceptance of material by the aquifer). As an optional pre-treatment step, pump one to two gallons of tap water into the aquifer to enhance dispersion pathways from the probe hole.

10b. **<u>Backfill Application</u>**: Pump the pre-determined quantity of ORC/ORC *Advanced* slurry into the borehole being treated. Observe pump pressure levels for indications of slurry dispersion

and/or slurry refusal into aquifer (increasing pressure indicates reduced acceptance of material by the aquifer).

11. Remove one four-foot section of the drive rod. If the drive rod contains slurry, return it to the ORC/ORC *Advanced* bucket/pump hopper for reuse.

12. Repeat steps 10 and 11 until treatment of the entire targeted thickness has been achieved. It is generally recommended that the procedure extend to the top of the capillary fringe/smear zone.

13. Place an appropriate seal, such as bentonite, above the ORC/ORC *Advanced* slurry through the entire vadose zone. This helps ensure that the slurry stays in place and prevents contaminants from migrating go the surface. Depending on soil conditions and local regulations, a bentonite seal can be pumped through the grout pump or added via chips or pellets after the drive rods have been removed.

14. Remove and decontaminate the drive rods and pre-probe (optional).

15. Finish the probe hole at surface as appropriate (concrete or asphalt cap, if necessary).

16. Move to the next injection point, repeating steps 5 through 15.

## HELPFUL HINTS

### *1) Physical characteristics*

The ORC/ORC *Advanced* slurry is made using the dry ORC/ORC *Advanced* powder makes a smooth slurry, the consistency of which depends on the amount of water used.

A 65-67% solids content ORC/ORC *Advanced* slurry (consistency of toothpaste) is thick but can still be pumped easily. This solids content slurry is normally used for back filling a borehole or probe hole. It is especially useful in situations where maximum density is desired, such as when ground water is present in the hole or when there are heaving sands.

As a rule, it is best to mix the first batch of slurry at the maximum solids content one would expect to use. The slurry can then be thinned by adding water in small increments. By monitoring this process, the appropriate quantities of water for subsequent batches can be determined.

The slurry should be mixed at about the time it is expected to be used. It is best not to hold it for longer than 30 minutes. Thinner slurries can experience separation if they stand too long. All solids content ORC/ORC *Advanced* slurries have a tendency to form a weak cement when left standing for extended periods or time. If a slurry begins to thicken too much, it should be mixed again and additional water should be added.

The ORC/ORC *Advanced* slurry should not be left sitting inside a grout pump or hose for extended periods because it will begin to set-up and harden. This problem can generally be avoided by re-circulating the slurry through the pump and hose back into the pump's hopper or mixing tank.

**2) *Pump Equipment Cleaning and Maintenance***

Pumping equipment and drive rods can be lightly cleaned by circulating clear water through them. If necessary, further cleaning and decontamination should be performed according to the equipment supplier's standard procedures and local regulatory requirements.

**3) *General Operating Procedures for Backfill Applications***

When performing a backfill installation, it is important to fill the appropriate portion of the hole with a thick (65-67% solids content) slurry that will solidify in place. Moderate amounts of pressure should be used to avoid fracturing the soil matrix or pumping slurry into the soil.

The operator should use care and monitor pumping pressures and quantities to ensure that the hole is being filled without pushing excess material into the soil matrix. Ideally, the rate of slurry pumping will be coordinated with the rate of drive rod withdrawal. It is usually important to install the slurry material to the top of the capillary fringe.

In addition, it is important that the entire contaminated saturated zone is treated (including the capillary fringe), as this is often the location of highest contaminant concentrations. Failure to properly treat this area can undermine an otherwise successful remediation effort.

® **ORC is a registered trademark of Regenesis Bioremediation Products**

**1011 Calle Sombra · San Clemente, CA 92673 · tel: 949.366.8000 · fax: 949.366.8090**

**tech@regenesis.com · www.regenesis.com**

PRICE SHEET
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Fax 949-366-8090

Effective Date: August 1, 2006

RegenOx™
CHEMICAL OXIDATION REDEFINED...

*RegenOx™ is an advanced in situ chemical oxidation technology* designed to treat organic contaminants including high concentration source areas in the saturated and vadose zones.*

**RegenOx Pricing**

Regenesis offers a volume discount structure for the purchase of RegenOx as follows:

| Quantity (lbs.) | RegenOx Price/lb. (US $) | Quantity (lbs.) | RegenOx Price/lb.(US$) |
|---|---|---|---|
| <5,000 | 2.45 | 20,000-29,999 | 1.95 |
| 5,000-9,999 | 2.20 | 30,000 – 49,999 | 1.90 |
| 10,000 – 19,999 | 2.05 | > 50,000 | Contact Regenesis |

* RegenOx is shipped in five gallon containers weighing approximately 30 pounds. Material Safety Data Sheet is included with each shipment.

**Freight** – All freight is FOB Regenesis Warehouse. Shipping warehouse will be determined by inventory levels and proximity to destination.

**Minimum Order** – 1,080 pounds ($2,646.00)

**Bench-Scale Laboratory Testing**

Laboratory testing of soil and groundwater is available to confirm the ability of RegenOx to degrade site specific contamination. However, such testing is generally not required. Contact Regenesis for details on laboratory testing and sample requirements.

**Payment Terms** – Net 30 days. Accounts outstanding after 30 days will be assessed 1.5% interest per month. Accounts outstanding over 90 days will be re-invoiced at the undiscounted price of $2.45 per pound.

**Return Policy** – A 15% restocking fee will be charged for all returned product. Return freight must be prepaid. All requests to return product must be pre-approved by Regenesis. Returned product must be in original condition and no product will be accepted for return after a period of 90 days from time of delivery.

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* Patent applied for.

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* Patent applied for.

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ORC® ADVANCED
OXYGEN RELEASE COMPOUND

REGENESIS
Advanced Technologies for Groundwater Resources

Effective Date: August 15, 2006

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| **ORC Advanced Powder (Bulk Pricing)** | |
|---|---|
| **Quantity (lbs.)** | **Price/lb (US $)** |
| *50 – 999 | $8.95 |
| 1000-2499 | $8.75 |
| 2500-4999 | $8.50 |
| 5000-9999 | $8.25 |
| > 10,000 | Contact Regenesis |

NOTE: Bulk ORC Advanced Powder is shipped in five gallon PVC buckets weighing approximately 25 pounds each. Material Safety Data Sheet (MSDS) and Installation Instructions are included with each shipment.

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**Terms & Conditions:** Other Terms & Conditions are on reverse side.

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# Oxygen Release Compound Advanced (ORC Advanced™)
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**8. ASSISTANCE AND ADVICE.** Upon request, seller in its discretion will furnish as an accommodation to buyer such technical advice or assistance as is available in reference to the goods. Seller assumes no obligation or liability for the advice or assistance given or results obtained, all such advice or assistance being given and accepted at buyer's risk.

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ATTACHMENT E-3

EXCERPTS FROM COMPLETION REPORT FOR THE BUILDING 637 AREA,
PRESIDIO OF SAN FRANCISCO, CALIFORNIA (EKI, 2004)
TABLE 4 – STATUS OF GROUNDWATER MONITORING
FIGURE 2 – FINAL EXTENT OF EXCAVATIONS
FIGURE 3 – ORC TREATMENT AREAS AND MONITORING WELL NETWORK

REVIEWED BY: RR

TABLE 4
STATUS OF GROUNDWATER MONITORING - BUILDING 637 AREA
Presidio of San Francisco, California

| Well ID | Water-Bearing Zone | Objectives of Monitoring Well | Analytes and Analytical Methods (a) | Required Monitoring Frequency and Duration | Groundwater Monitoring Summary (b) | Proposed Future Work |
|---|---|---|---|---|---|---|
| 637-01R | A2 | Monitor groundwater flow direction in A2 Zone. Measure TPH-g and BTEX. | TPH-g (EPA 8015M) BTEX (EPA 8021B or 8260B) | Quarterly for 1 year. | Remedial activities were completed in March 2000. The Presidio Trust collected groundwater samples from this well 8 times from June 2000 to December 2002. The maximum TPH-g and xylenes concentrations detected in groundwater were 190 ug/l and 0.9 ug/l, respectively, which are less than the applicable groundwater cleanup levels for TPH-g and xylenes of 13,000 ug/l and 232,000 ug/l, respectively. Benzene, toluene, and ethylbenzene were not detected in groundwater samples. | NFA (c) |
| 637-19 | A2 | Monitor groundwater flow direction in A2 Zone. Measure TPH-g and BTEX. | TPH-g (EPA 8015M) BTEX (EPA 8021B or 8260B) | Quarterly for 1 year. | Remedial activities were completed in March 2000. The Presidio Trust collected groundwater samples from this well 7 times from May 2001 to December 2002. The maximum xylenes concentration detected in groundwater was 2.7 ug/l, which is less than the applicable groundwater cleanup level for xylenes of 232,000 ug/l. TPH-g, benzene, toluene, and ethylbenzene were not detected in groundwater samples. | NFA (c) |
| 637-26 | A1 | Monitor groundwater flow direction in A1 Zone. Measure TPH-g, BTEX, and DO downgradient of ORC treatment area. | TPH-g (EPA 8015M) BTEX (EPA 8021B or 8260B) DO (DO Field Probe) | Quarterly for 2 years. | Remedial activities were completed in March 2000. The Presidio Trust collected groundwater samples from this well 8 times from June 2000 to December 2002. The maximum TPH-g, ethylbenzene, and xylenes concentrations detected in groundwater were 620 ug/l, 2.4 ug/l, and 4.9 ug/l, respectively, which are less than the applicable groundwater cleanup levels for TPH-g, ethylbenzene, and xylenes of 13,000 ug/l, 1,000 ug/l, and 232,000 ug/l, respectively. Benzene and toluene were not detected in groundwater samples. | NFA (c) |

TABLE 4
**STATUS OF GROUNDWATER MONITORING - BUILDING 637 AREA**
Presidio of San Francisco, California

| Well ID | Water-Bearing Zone | Objectives of Monitoring Well | Analytes and Analytical Methods (a) | Required Monitoring Frequency and Duration | Groundwater Monitoring Summary (b) | Proposed Future Work |
|---|---|---|---|---|---|---|
| 637-27 | A1 | Monitor groundwater flow direction in A1 Zone. Measure TPH-g and BTEX. | TPH-g (EPA 8015M) BTEX (EPA 8021B or 8260B) | Quarterly for 1 year. | Remedial activities were completed in March 2000. The Presidio Trust collected groundwater samples from this well 7 times from May 2001 to December 2002. TPH-g and BTEX were not detected in groundwater samples. | NFA (c) |
| 637-33 | A2 | Monitor groundwater flow direction in A2 Zone. Measure TPH-g and BTEX. | TPH-g (EPA 8015M) BTEX (EPA 8021B or 8260B) | Quarterly for 1 year. | Remedial activities were completed in March 2000. The Presidio Trust collected groundwater samples from this well 7 times from May 2001 to December 2002. TPH-g and BTEX were not detected in groundwater samples. | NFA (c) |
| 637-34 | A1 | Monitor groundwater flow direction in A1 Zone. Wetland early-detection well (west of sentry wells). | TPH-g (EPA 8015M) BTEX (EPA 8021B or 8260B) | Quarterly for 2 years, semi-annually thereafter. (d) | Remedial activities were completed in March 2000. The Presidio Trust collected groundwater samples from this well 10 times from June 2000 to August 2003. TPH-g and BTEX were not detected in groundwater samples. | NFA (c) |
| 637-35 | A1 | Monitor groundwater flow direction in A1 Zone. Wetland sentry well. | TPH-g (EPA 8015M) BTEX (EPA 8021B or 8260B) | Quarterly for 2 years, semi-annually thereafter. (d) | Remedial activities were completed in March 2000. The Presidio Trust collected groundwater samples from this well 10 times from June 2000 to August 2003. The maximum xylenes concentration detected in groundwater was 0.63 ug/l, which is less than the applicable groundwater cleanup level for xylenes (within 150 feet of wetlands) of 130 ug/l. TPH-g, benzene, toluene, and ethylbenzene were not detected in groundwater samples. TPH-g and BTEX concentrations have been non-detect for 5 consecutive monitoring events. | NFA (c) |
| 637-36 | A1 | Monitor groundwater flow direction in A1 Zone. Wetland sentry well. | TPH-g (EPA 8015M) BTEX (EPA 8021B or 8260B) | Quarterly for 2 years, semi-annually thereafter. (d) | Remedial activities were completed in March 2000. The Presidio Trust collected groundwater samples from this well 10 times from May 2001 to August 2003. TPH-g and BTEX were not detected in groundwater samples. | NFA (c) |

TABLE 4
STATUS OF GROUNDWATER MONITORING - BUILDING 637 AREA
Presidio of San Francisco, California

| Well ID | Water-Bearing Zone | Objectives of Monitoring Well | Analytes and Analytical Methods (a) | Required Monitoring Frequency and Duration | Groundwater Monitoring Summary (b) | Proposed Future Work |
|---|---|---|---|---|---|---|
| 637-37 | A1 | Monitor groundwater flow direction in A1 Zone. Wetland sentry well. | TPH-g (EPA 8015M) BTEX (EPA 8021B or 8260B) | Quarterly for 2 years, semi-annually thereafter. (d) | Remedial activities were completed in March 2000. The Presidio Trust collected groundwater samples from this well 10 times from June 2000 to August 2003. TPH-g and BTEX were not detected in groundwater samples above laboratory reporting limits. | NFA (c) |
| 637-38 | A1 | Monitor groundwater flow direction in A1 Zone. Measure TPH-g, BTEX, and DO downgradient of ORC treatment area. | TPH-g (EPA 8015M) BTEX (EPA 8021B or 8260B) DO (DO Field Probe) | Quarterly for 2 years. | Remedial activities were completed in March 2000. The Presidio Trust collected groundwater samples from this well 9 times from June 2000 to March 2003. The maximum TPH-g, toluene, and xylenes concentrations detected in groundwater were 320 ug/l, 4.8 ug/l, and 1.2 ug/l, respectively, which are less than the applicable groundwater cleanup levels for TPH-g, toluene, and xylenes of 13,000 ug/l, 2,100 ug/l, and 232,000 ug/l, respectively. Benzene and ethylbenzene were not detected in groundwater samples. | NFA (c) |
| 637-39R | A1 | Monitor groundwater flow direction in A1 Zone. Measure TPH-g, BTEX, and DO downgradient of ORC treatment area. | TPH-g (EPA 8015M) BTEX (EPA 8021B or 8260B) DO (DO Field Probe) | Quarterly for 2 years. | Remedial activities were completed in March 2000. The Presidio Trust collected groundwater samples from this well 7 times from August 2001 to March 2003. TPH-g and BTEX were not detected in groundwater samples. | NFA (c) |

TABLE 4
STATUS OF GROUNDWATER MONITORING - BUILDING 637 AREA
Presidio of San Francisco, California

| Well ID | Water-Bearing Zone | Objectives of Monitoring Well | Analytes and Analytical Methods (a) | Required Monitoring Frequency and Duration | Groundwater Monitoring Summary (b) | Proposed Future Work |
|---|---|---|---|---|---|---|
| 637-40 | A2 | Monitor groundwater flow direction in A2 Zone. Measure HVOC concentrations until MCLs are achieved. | HVOCs (EPA 8260) | Annually until MCLs achieved for 2 consecutive monitoring events. | Remedial activities were completed in March 2000. The Presidio Trust collected groundwater samples from this well 8 times from May 2001 to March 2003. The maximum TPH-g, benzene, toluene, ethylbenzene, and xylenes concentrations detected in groundwater were 85 ug/l, 0.88 ug/l, 0.97 ug/l, 1.2 ug/l, and 5.6 ug/l, respectively. These concentrations are less than the applicable groundwater cleanup levels for TPH-g, benzene, toluene, ethylbenzene, and xylenes of 13,000 ug/l, 650 ug/l, 2,100 ug/l, 1,000 ug/l, and 232,000 ug/l, respectively. The maximum acetone, c-1,2-DCE, PCE, and vinyl chloride concentrations detected in groundwater were 20 ug/l, 0.9 ug/l, 1.7 ug/l, and 1.1 ug/l, respectively. An MCL for acetone does not exist. The c-1,2-DCE and PCE concentrations are less than their MCLs of 6 ug/l and 5 ug/l, respectively. The maximum vinyl chloride concentration is greater than its MCL of 0.5 ug/l. No other VOCs have been detected. All HVOC concentrations have been below their MCLs for the 2 most recent consecutive monitoring events; thus, the HVOC cleanup level has been met. | NFA (c) |

TABLE 4
STATUS OF GROUNDWATER MONITORING - BUILDING 637 AREA
Presidio of San Francisco, California

| Well ID | Water-Bearing Zone | Objectives of Monitoring Well | Analytes and Analytical Methods (a) | Required Monitoring Frequency and Duration | Groundwater Monitoring Summary (b) | Proposed Future Work |
|---|---|---|---|---|---|---|
| LF07GW11 | A1 | Monitor groundwater flow direction in A1 Zone. Measure TPH-g, BTEX, and DO downgradient of ORC treatment area. | TPH-g (EPA 8015M)<br>BTEX (EPA 8021B or 8260B)<br>DO (DO Field Probe) | Quarterly for 2 years. | Remedial activities were completed in March 2000. The Presidio Trust collected groundwater samples from this well 9 times from July 2000 to December 2002. The maximum TPH-g, benzene, toluene, and xylenes concentrations detected in groundwater were 240 ug/l, 2.6 ug/l, 0.7 ug/l, and 0.73 ug/l, respectively. These concentrations are less than the applicable groundwater cleanup levels for TPH-g, benzene, toluene, and xylenes of 13,000 ug/l, 650 ug/l, 2,100 ug/l, and 232,000 ug/l, respectively. Ethylbenzene has not been detected in groundwater samples. | NFA (c) |

Notes:

(a) Analytical methods are U.S. Environmental Protection Agency methods (SW-846, Update III), unless otherwise indicated.

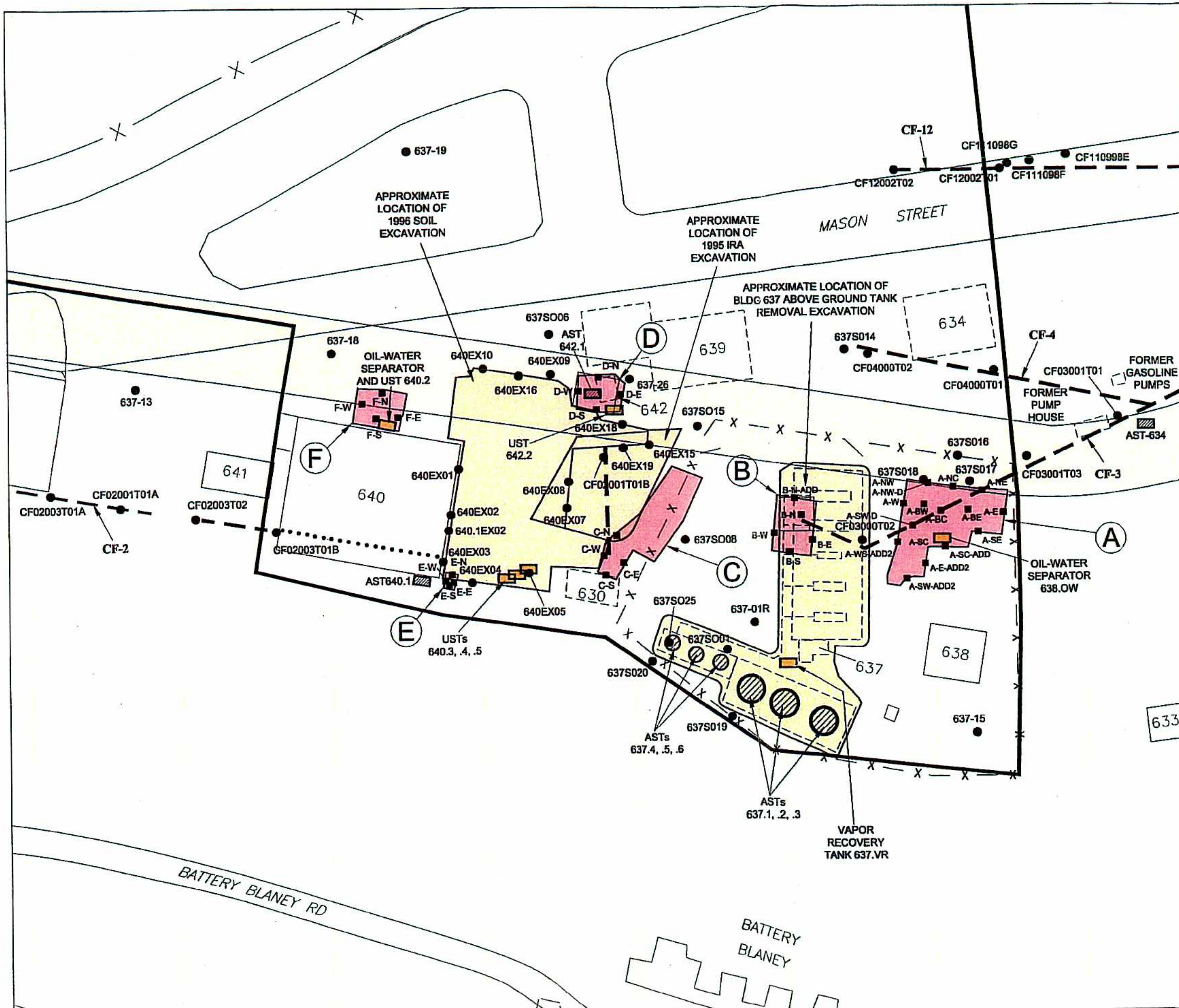
(b) Groundwater monitoring data are tabulated in Appendix B of this document.

(c) The results of groundwater monitoring indicated the requirements of the CAP have been met and no further action ("NFA") is necessary for groundwater, except for the proper decommissioning of the existing monitoring wells.

(d) In accordance with the CAP, the Trust may request to terminate groundwater monitoring after 3 years if at least one of the following conditions is met: (1) the groundwater flow direction in the Building 637 Area is consistently to the north or northwest (i.e., not toward the wetlands); (2) TPH-g has not been detected in the wells for the last four consecutive rounds of monitoring; or (3) the trend of TPH-g concentrations is shown to be stable or decreasing using a statistical evaluation.

Abbreviations:

| | |
|---|---|
| BTEX | benzene, toluene, ethylbenzene, and xylenes |
| c-1,2-DCE | cis-1,2-dichloroethene |
| CAP | Final Corrective Action Plan, Building 637 Area |
| DO | dissolved oxygen |
| HVOCs | halogenated volatile organic chemicals |
| MCLs | Maximum Contaminant Levels |
| NFA | no further action |
| ORC | Oxygen Release Compound, provided by Regenesis |
| PCE | tetrachloroethene |
| TPH-g | total petroleum hydrocarbons quantified as gasoline |
| VOCs | volatile organic compounds |




N

0 60 120

(Approximate Scale in Feet)

## LEGEND

| | |
|---|---|
| | Building 637 Area Boundary |
| —x— | Fence |
| | Former Building or Structure Location |
| | Mason Street Realignment |
| | Former Aboveground Storage Tank (AST) Location |
| | Former Underground Storage Tank (UST) Location |
| | Shallow Soil Sampling Location |
| | Trust Confirmation Soil Sampling Location |
| | Army Excavation Area |
| | Trust Excavation Area |
| | Former Fuel Distribution System (FDS) Line |
| | FDS Line Abandoned in Place |
| 634 | Building and Number |
| A | Trust Excavation Area ID |
| CF-2 | FDS Section ID |

**Notes:**

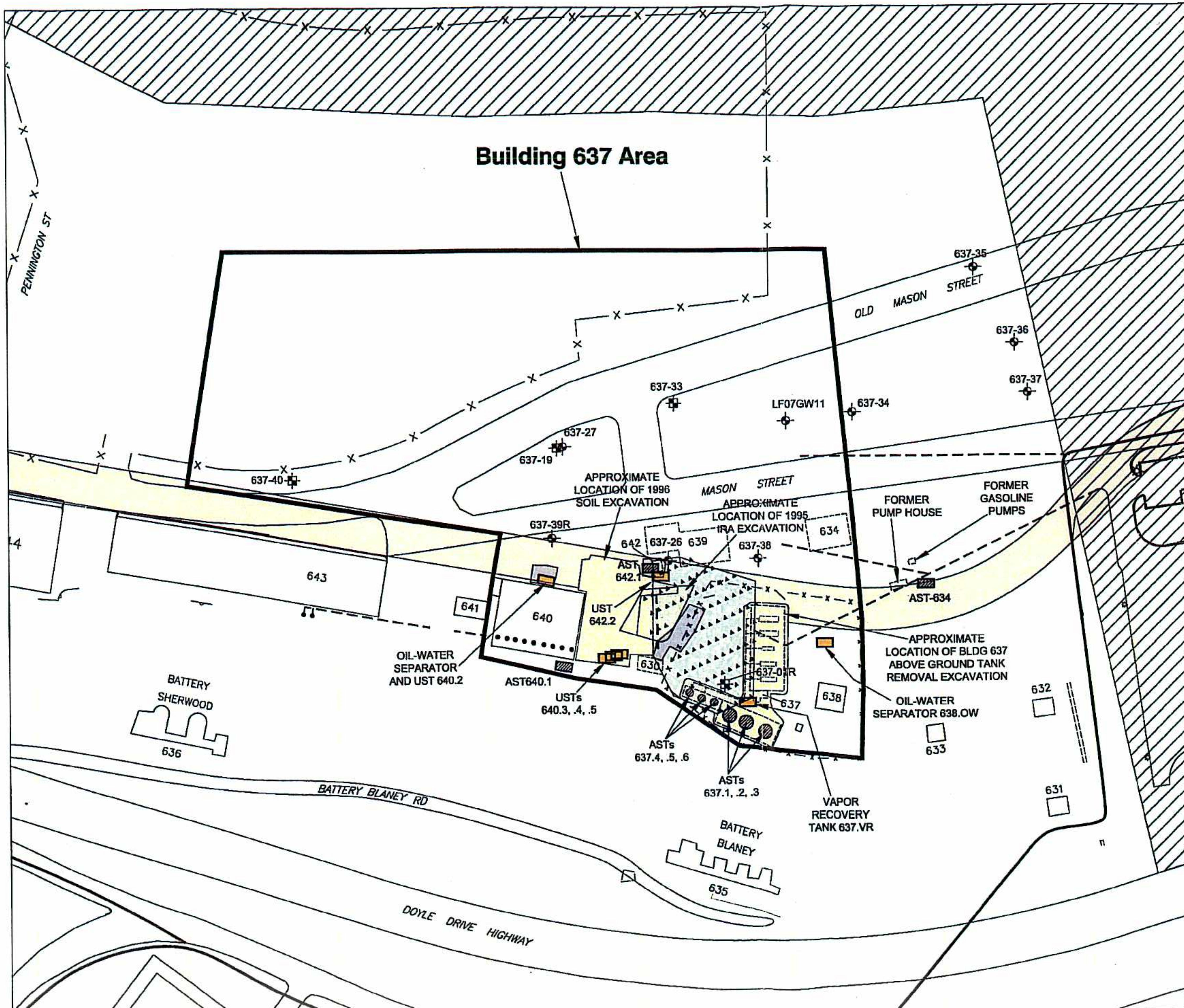
1. All locations are approximate.
2. Base map was provided by Department of the Interior, National Park Service.
3. The size and orientation of the USTs and ASTs are schematic (e.g., not representative of actual sizes).
4. Shallow soil indicates soil samples collected from depths less than 4 feet below ground surface ("bgs").
5. The northern portion of Area C was excavated to fixed dimensions; confirmation sampling was not conducted.

**Erler & Kalinowski, Inc.**

Final Extent of Excavations
Building 637 Area

THE PRESIDIO TRUST

Presidio Trust
San Francisco, CA
March 2004
EKI A000003.10
Figure 2




## LEGEND

- Fence
- Former Building or Structure Location
- Mason Street Realignment
- A1 Zone Monitoring Well
- A2 Zone Monitoring Well
- Saltwater Ecological Protection Zone
- Former Aboveground Storage Tank (AST) Location
- Former Underground Storage Tank (UST) Location
- Former Excavation Area
- Former Fuel Distribution System (FDS) Line
- FDS Line Abandoned in Place
- 634 Building and Number
- Location Where ORC was Placed Excavation Backfill (4 to 6 feet bgs)
- Approximate ORC Injection Area ("▸" Represents Approximate ORC Injection Point)

**Notes:**

1. All locations are approximate.
2. Base map was provided by Department of the Interior, National Park Service.
3. The size and orientation of the USTs and ASTs are schematic (e.g., not representative of actual sizes).

**Erler & Kalinowski, Inc.**

ORC Treatment Areas and Monitoring Well Network
Building 637 Area

Presidio Trust
San Francisco, CA
March 2004
EKI A000003.10

THE PRESIDIO TRUST

Figure 3

APPENDIX F

STANDARD OPERATING PROCEDURES (SOPS) FOR
SOIL SAMPLING AND MONITORING WELL INSTALLATION ACTIVITIES

REVIEWED BY: MS

APPENDIX F

Contents

SOP APPROVAL FORM

THE PRESIDIO TRUST

ENVIRONMENTAL STANDARD OPERATING PROCEDURE

SOIL SAMPLING

SOP NO. 001

REVISION NO. 00

Last Reviewed: December 2000

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12 JAN 01

Date

Checked MS

Approved

## 1.0 BACKGROUND

Soil sampling is conducted for three main reasons. First, samples can be obtained for laboratory chemical analysis. Second, samples can be obtained for laboratory physical analysis. Third, samples can be obtained for visual classification and field screening. These three sampling objectives can be achieved separately or in combination with each other. Sampling locations are typically chosen to provide chemical, physical, or visual information in both the horizontal and vertical directions. A sampling and analysis plan is used to outline sampling methods and provide preliminary rationale for sampling locations. Sampling locations may be adjusted in the field based on the screening methods being used and the physical features of the area.

### 1.1 PURPOSE

Soil sampling is conducted to determine the chemical, physical, and visual characteristics of surface and subsurface soils.

### 1.2 SCOPE

This standard operating procedure (SOP) describes procedures for soil sampling in different areas using various implements. It includes procedures for test pit, surface soil, and subsurface soil sampling, and describes eight devices. It also discusses procedures for collecting soil samples for volatile organic compound (VOC) analysis using the EnCore™ soil sampler system.

### 1.3 DEFINITIONS

**Hand Auger:** Instrument attached to the bottom of a length of pipe that has a crossarm or "T"-handle at the top. The auger can be closed-spiral or open-spiral.

**Bucket Auger:** A type of auger that consists of a cylindrical bucket 10 to 72 inches in diameter with teeth arranged at the bottom.

**Core Sampler:** Thin-wall cylindrical metal tube with diameter of 0.5 to 3 inches, a tapered nosepiece, a T-handle to facilitate sampler deployment and retrieval, and a check valve (flutter valve) in the headpiece.

**Spatulas or Spoons:** Stainless steel instruments for collecting loose unconsolidated material.

**Trier:** Tube cut in half lengthwise with a sharpened tip that allows for collection of sticky solids or loosening of cohesive soils.

**Trowel:** Tool with a scooped blade 4 to 8 inches long and 2 to 3 inches wide and has a handle.

**Split-Spoon (or Split-Barrel) Sampler:** Thick-walled steel tube that is split lengthwise. A cutting shoe is attached to the lower end; the upper end contains a check valve and is connected to drill rods.

**Thin-Wall Tube Sampler:** Steel tube (1 to 3 millimeters thick) with tapered bottom edge for cutting. The upper end is fastened to a check valve that is attached to drill rods.

## 1.4 REFERENCES

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EPA. 1991. "Handbook of Suggested Practices for the Design and Installation of Groundwater Monitoring Wells." EPA/600/4-89/034. March.

EPA. 1994. "Soil Sampling." Environmental Response Team SOP No. 2012. Revision No. 0.0. November 16. (On-Line Address: http://www.ert.org/media_resrcs/media_resrcs.asp.)

## 1.5 REQUIREMENTS AND RESOURCES

Soil sampling requires that one or more of the following types of equipment be used:

| Sampling Equipment | Other Required Equipment |
|---|---|
| Spoons and spatulas | Sample containers, labels, and chain-of-custody forms |
| Trowel | Logbook |
| Shovel or spade | Measuring tape |
| Trier | Soil classification guidelines |
| Core sampler | Wax for sealing ends of thin-wall tube |

| | |
|---|---|
| Hand auger | Plastic sheeting |
| Bucket auger | Decontamination equipment |
| Split-spoon | Drilling equipment |
| Thin-wall tube | Backhoe |
| | Health and safety equipment |

## 2.0 PROCEDURES

This SOP presents procedures for conducting test pit, surface soil, and subsurface soil sampling. The project-specific field sampling plan will specify which of the following procedures will be used.

Soil samples for chemical analysis should be collected in the following order: (1) VOCs, (2) semivolatile organic compounds, and (3) metals. Once the chemical samples have been containerized, samples for physical analyses can be containerized. Typical physical analyses conducted include (1) grain size distribution, (2) moisture content, (3) saturated permeability, (4) unsaturated permeability, and (5) Atterberg limits. Additionally, visual descriptions of samples, using the Unified Soil Classification System (USCS), should be recorded. Soil samples for chemical analyses can be collected either as grab samples or composite samples. A grab sample is collected from a discrete location or depth. A composite sample consists of soil combined from more than one discrete location. Typically, composite samples consist of soil obtained from several locations and homogenized in a stainless steel or Teflon® pan or tray. Samples for VOC analysis should not be composited.

### 2.1 TEST PIT SOIL SAMPLING

Test pit soil sampling is conducted when a complete soil profile is required or as a means of locating visually detectable contamination or sources, such as debris and underground storage tanks. This type of sampling provides a detailed description of the soil profile and allows for multiple samples to be collected from specific soil horizons. Before conducting any test pit or trench excavation with a backhoe, the sampling team should ensure that the sampling area is clear of utility lines, subsurface pipes, and poles. Any intrusive activities require Trust project review and permit issuance.

A test pit or trench is excavated by incrementally removing soil material with a backhoe bucket. The excavated soil may be placed on plastic sheeting (or other means of segregation), well away from the edge of the test pit. A test pit with depths greater than 4 feet must have its walls properly stabilized

according to Occupational Safety and Health Administration standards if personnel access to the pit is required. In many applications, sampling from the backhoe bucket will be preferred.

Personnel entering the test pit may be exposed to toxic or explosive gases and oxygen deficient environments. Air monitoring is required before entering the test pit and the use of appropriate respiratory gear and protective clothing is mandatory. At least two persons must be present at the test pit before sampling personnel enter the excavation and begin soil sampling.

Test pits are not practical for depths greater than 15 feet. If soil samples are required from depths greater than 15 feet, samples should be obtained using test borings instead of test pits. Test pits are also usually limited to a few feet below the water table. In some cases, a pumping system may be required to control the water level within the pits.

Access to open test pits should be restricted by use of flagging, tape, or fencing. If a fence is used, it should be erected at least 6 feet from the perimeter of the test pit. The test pit should be backfilled as soon as possible after sampling is completed.

Soil samples can be collected from the walls or bottom of a test pit using various equipment. A hand auger, bucket auger, or core sampler can be used to obtain samples from various depths. A trier, trowel, or spoons can be used to obtain samples from the walls or pit bottom surface.

## 2.2 SURFACE SOIL SAMPLING

The surface (and near surface) soil sampling equipment presented in this SOP is best suited for sampling to depths of 0 to 6 feet below ground surface (bgs). The sample depth, sample analyses, soil type, and soil moisture will also dictate the best-suited sampling equipment. Before sample collection, the sampling locations should be cleared of any surface debris such as twigs, rocks, and litter. The following table presents various surface soil sampling equipment and their effective depth ranges, operating means (manual or power), and sample types collected (disturbed or undisturbed).

| Sampling Equipment | Effective Depth Range (feet bgs) | Operating Means | Sample Type |
|---|---|---|---|
| Hand Auger | 0 to 6 | Manual | Disturbed |
| Bucket Auger | 0 to 4 | Power | Disturbed |
| Core Sampler | 0 to 4 | Manual or Power | Undisturbed |

| | | | |
|---|---|---|---|
| Shovel | 0 to 6 | Manual | Disturbed |
| Trier | 0 to 1 | Manual | Disturbed |
| Trowel | 0 to 1 | Manual | Disturbed |
| Spoon/Spatula | 0 to 0.5 | Manual | Disturbed |

The procedures for using these various types of sampling equipment are discussed below.

### 2.2.1 Hand Auger

A hand auger equipped with extensions and a T-handle is used to obtain samples from a depth of up to 6 feet below ground surface. If necessary, a shovel may be used to excavate the topsoil to reach the desired subsoil level. If topsoil is removed, its thickness should be recorded. Samples obtained using a hand auger are disturbed in their collection; determining the exact depth at which samples are obtained is difficult.

The hand auger is screwed into the soil at an angle of 45 to 90 degrees from horizontal. When the entire auger blade has penetrated soil, the auger is removed from the soil by lifting it straight up without turning it, if possible. If the desired sampling depth has not been reached, the soil is removed from the auger and deposited onto plastic sheeting. This procedure is repeated until the desired depth is reached and the soil sample is obtained. The auger is then removed from the boring and the soil sample is collected directly from the auger into an appropriate sample container.

### 2.2.2 Bucket Auger

A bucket auger, equipped similarly as the hand auger, is used to obtain disturbed samples from a depth of up to 4 feet. A bucket auger should be used when sampling stony or dense soil that prohibits the use of a hand-operated core or screw auger. A bucket auger with closed blades is used in soil that cannot generally be penetrated or retrieved by a core sampler.

The bucket auger is rotated while downward pressure is exerted until the bucket is full. The bucket is then removed from the boring, the collected soil is placed on plastic sheeting, and this procedure is repeated until the appropriate depth is reached and a sample is obtained. The bucket is then removed from the boring and the soil sample is transferred from the bucket to an appropriate sample container.

### 2.2.3 Core Sampler

A hand-operated core sampler (Figure 1), similarly equipped as the hand auger, is used to obtain samples from a depth of up to 4 feet in uncompacted soil. The core sampler is capable of retrieving undisturbed soil samples and is appropriate when low concentrations of metals or organics are of concern. The core sampler should be constructed of stainless steel. A polypropylene core sampler is generally not suitable for sampling dense soils or sampling at an appreciable depth.

The core sampler is pressed into the soil at an angle of 45 to 90 degrees from horizontal and is rotated when the desired depth is reached. The core is then removed, and the sample is placed into an appropriate sample container.

### 2.2.4 Shovel

A shovel may be used to obtain large quantities of soil that are not readily obtained with a trowel but is not recommended. A shovel is used when soil samples from a depth of up to 6 feet are to be collected by hand excavation; a tiling spade (sharpshooter) is recommended for excavation and sampling. A standard steel shovel may be used for excavation; either a stainless steel or polypropylene shovel may be used for sampling. Soil excavated from above the desired sampling depth should be stockpiled on plastic sheeting. Soil samples should be collected from the shovel and placed into the sample container using a stainless-steel scoop, plastic spoon, or other appropriate tool.

### 2.2.5 Trier

A trier (Figure 2) is used to sample soil from a depth of up to 1 foot. A trier should be made of stainless steel or polypropylene. A chrome-plated steel trier may be suitable when samples are to be analyzed for organics and heavy metal content is not a concern.

Samples are obtained by inserting the trier into soil at an angle of up to 45 degrees from horizontal. The trier is rotated to cut a core and is then pulled from the soil being sampled. The sample is then transferred to an appropriate sample container.

### 2.2.6 Trowel

A trowel is used to obtain surface soil samples that do not require excavation beyond a depth of 1 foot. A trowel may also be used to collect soil subsamples from profiles exposed in test pits. Use of a trowel is practical when sample volumes of approximately 1 pint (0.5 liter) or less are to be obtained. Excess soil should be placed on plastic sheeting until sampling is completed. A trowel should be made of stainless steel (or galvanized steel for samples that are analyzed for metals). It can be purchased from a hardware or garden store. Soil samples to be analyzed for organics should be collected using a stainless steel trowel. Samples may be placed directly from the trowel into sample containers.

## 2.3 SUBSURFACE SOIL SAMPLING

Subsurface soil sampling, in conjunction with borehole drilling, is required for soil sampling from depths greater than approximately 6 feet. Subsurface soil sampling is frequently coupled with exploratory boreholes or monitoring well installation. Refer to SOP No. 004 for monitoring well installation and borehole drilling procedures. Prior to intrusive soil sampling activities, site utilities may be required to be cleared by a qualified utility locator. As noted previously, intrusive soil activities also require Trust project review and permit issuance.

Subsurface soil sampling may be conducted using a drilling rig or power auger. Selection of sampling equipment depends upon geologic conditions and the scope of the sampling program. Two types of samplers used with machine-driven augers—the split-spoon sampler and the thin-wall tube sampler—are discussed below. All sampling tools should be cleaned before and after each use in accordance with SOP No. 014 (General Equipment Decontamination). Both the split-spoon sampler and the thin-wall tube sampler can be used to collect undisturbed samples from unconsolidated soils. Direct-push methods are commonly used to drive tube samplers equipped with acetate or brass sleeves. Acetate sleeves permit the recovery of a continuous core (typically 4-foot lengths) that can be divided for chemical or other analyses. The procedures for using the split-spoon and thin-wall tube samplers are presented below.

### 2.3.1 Split-Spoon Sampler

Split-spoon samplers are available in a variety of types and sizes. Site conditions and project needs (such as large sample volume for multiple analyses) determine the specific type of split-spoon sampler to be used. Figure 3 shows a generic split-spoon sampler.

The split-spoon sampler is advanced into the undisturbed soil beneath the bottom of the casing or borehole using a weighted hammer and a drill rod. The relationship between hammer weight, hammer drop, and number of blows required to advance the split-spoon sampler in 6-inch increments indicates the density or consistency of the subsurface soil. After the split-spoon sampler has been driven to its intended depth, it should be removed carefully to avoid loss of sample material. In noncohesive or saturated soil, a catcher or basket should be used to help retain the sample.

After the split-spoon sampler is removed from the casing, it is detached from the drill rod and opened. If VOC samples are to be collected, EnCore™ samplers should be filled with soil taken directly from the split-spoon sampler (see Section 2.4). Samples for other specific chemical analyses should be taken as soon as the VOC sample has been collected. The remainder of the recovered soil can then be used for visual classification of the sample and containerized for physical analysis. The entire sample (except for the top several inches of possibly disturbed material) is retained for analysis or disposal.

### 2.3.2 Thin-Wall Tube Sampler

A thin-wall tube sampler, sometimes called the Shelby tube (Figure 4), may be pressed or driven into soil inside a hollow-stem auger flight, wash bore casing, or uncased borehole. The tube sampler is pressed into the soil without rotation to the desired depth or until refusal. If the tube cannot be advanced by pushing, it may be necessary to drive it into the soil without rotation using a hammer and drill rod. The tube sampler is then rotated to collect the sample from the soil and removed from the borehole.

After removal of the tube sampler from the drilling equipment, the tube sampler should be inspected for adequate sample recovery. The sampling procedure should be repeated until an adequate soil core is obtained (if sample material can be retained by the tube sampler). The soil core obtained should be documented in the logbook. Any disturbed soil is removed from each end of the tube sampler. If chemical analysis is required, VOC samples must be collected immediately after the tube sampler is withdrawn (see Section 2.4). Before use, and during storage and transport, the tube sampler should be capped with a nonreactive material. For physical sampling parameters, the tube sampler should be sealed by pouring three 0.25-inch layers of sealing liquid (such as wax) in each end, allowing each layer to solidify before applying the next. The remaining space at each end of the tube is filled with Ottawa sand or other, similar sand, which is allowed to settle and compact. Plastic caps are then taped over the ends of the tube. The top and bottom of the tube sampler should be labeled and the tube sampler should be stored accordingly.

## 2.4 ENCORE™ SOIL SAMPLER SYSTEM FOR VOC ANALYSES

The EnCore™ soil sampler system is a dedicated system designed to collect, store, and deliver an approximately 5- or 25-gram soil sample in a zero-headspace container. The samplers are applicable to the collection of samples for VOC analyses (including chlorinated and aromatic VOCs and purgeable total petroleum hydrocarbons). No preservation chemicals are needed in the field. Extrusion and extraction of the whole sample in the sampler is done in the laboratory. No subsampling of the individual container is necessary. The EnCore™ sampler is a single use device and cannot be cleaned or reused. The EnCore™ system consists of the following four components:

- A cartridge with moveable plunger
- A cap with two locking arms
- A T-handle to aid in sampling
- An extrusion handle used in the laboratory

The soil collected in the EnCore™ sampler is stored in a sealed, headspace-free state. Three Viton "O"-rings achieve the seals (two located on the plunger and one on the cap of the sampler). For correct sealing, these O-rings must not be removed or disturbed.

The following procedures should be followed to collect a soil sample with the EnCore™ sampler:

- Before collecting the sample, hold the coring body and push the plunger rod down until small rod rests against the tabs (to ensure that the plunger moves freely). Then, depress locking lever on T-handle and place the coring body, plunger end first, into the open end of the T-handle, aligning the two slots on the coring body with the two locking pins in the T-handle. Twist the coring body clockwise to lock the pins in the slot. Check to ensure sampler is locked in place.

- Turn the T-handle such that the "T" is up and the coring body is down. This position leaves the plunger body flush with the bottom of the coring body. Holding the T-handle, push and twist the sampler into the soil until the coring body is completely full. When the sampler is full, the small O-ring on the plunger rod will be centered in the T-handle viewing hole (the upper hole for the 25-gram sampler and the lower hole for the 5-gram sampler). Remove the sampler from the soil.

- Before capping the sampler, wipe excess soil from the coring body exterior, ridge area, and any soil that may protrude beyond the opening end of the coring body to ensure proper sealing. Cap the coring body while it is still on the T-handle. Continue as above until three samples have been collected from the location. If only VOCs are to be analyzed for a given location, a small jar (minimum 2 ounce) of sample must be collected to allow for moisture content analysis.

When sampling surface soils, apply the EnCore™ sampler to a freshly exposed soil surface, following the procedures described above. When sampling subsurface soils, EnCore™ samples should be collected from one of the open ends of a sleeve core immediately upon retrieval.

The EnCore™ sampling system cannot be reliably used as stated above to sample sand, loose soil, or sediment since a cohesive plug will not be formed with these materials. When working with these soils, pull the plunger all the way back and lock it. Turn the sampler upside down and scoop the material into the coring body and cap it. Make a note of this method deviation in the field notebook.

Place the three collocated samples for each VOC analysis into one zipper bag. Seal the bag, place it into a prechilled cooler maintained at 4°C, and ship the samples to the laboratory for preservation and analysis. The recommended holding time between sampling and preservation by the laboratory is 48 hours. The recommended holding time between preservation and analysis is 14 days. The laboratory will preserve two EnCore™ containers using sodium bisulfate and one container using methanol. This allows for both low-level and high-level analysis of the sample.

**FIGURE 1**

**HAND-OPERATED CORE SAMPLER**

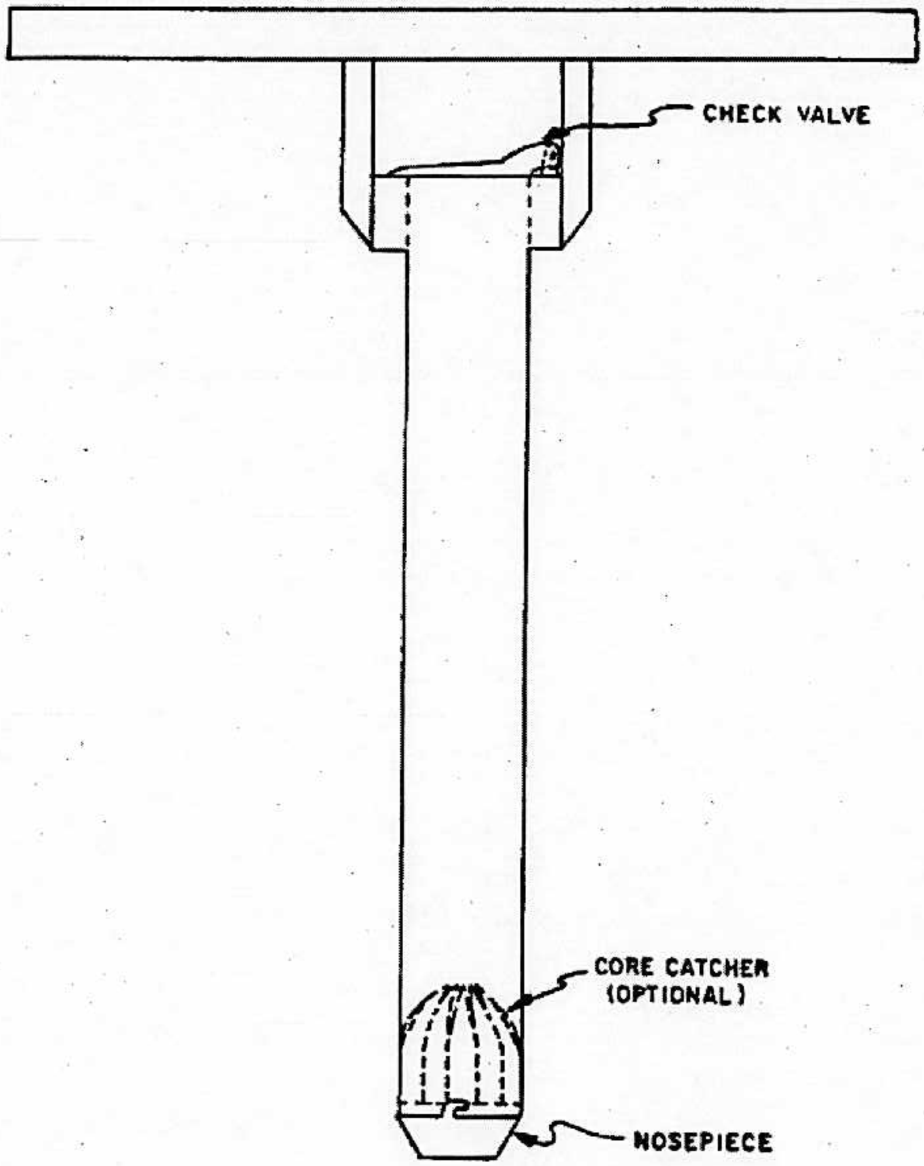


**FIGURE 2**

**TRIER**

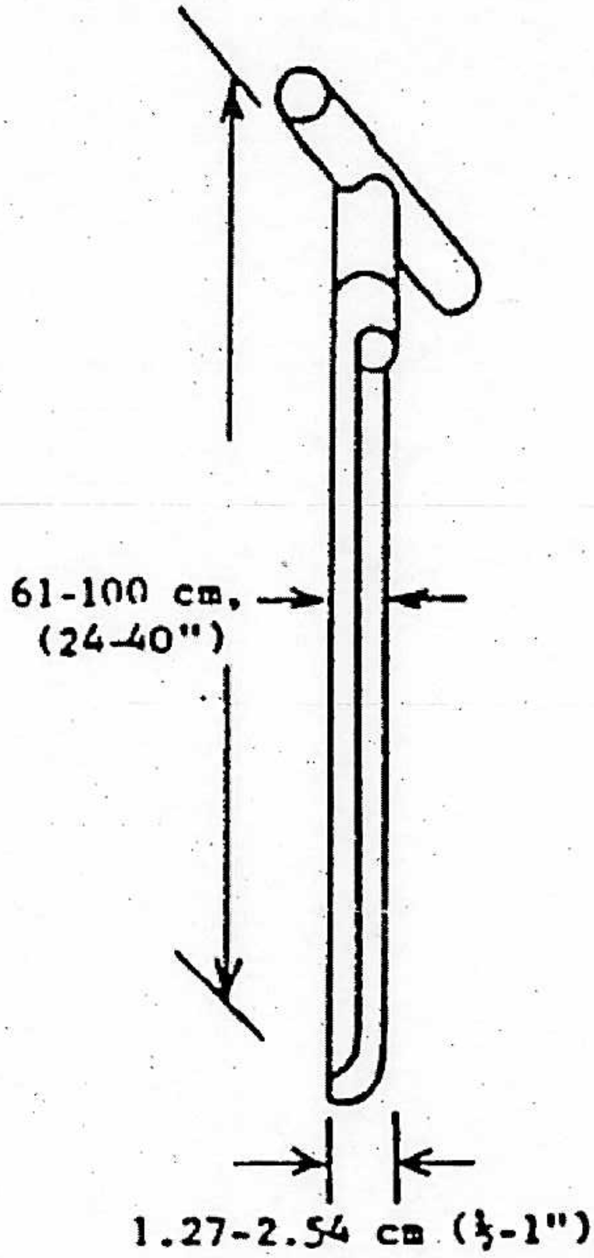


**FIGURE 3**

**GENERIC SPLIT-SPOON SAMPLER**

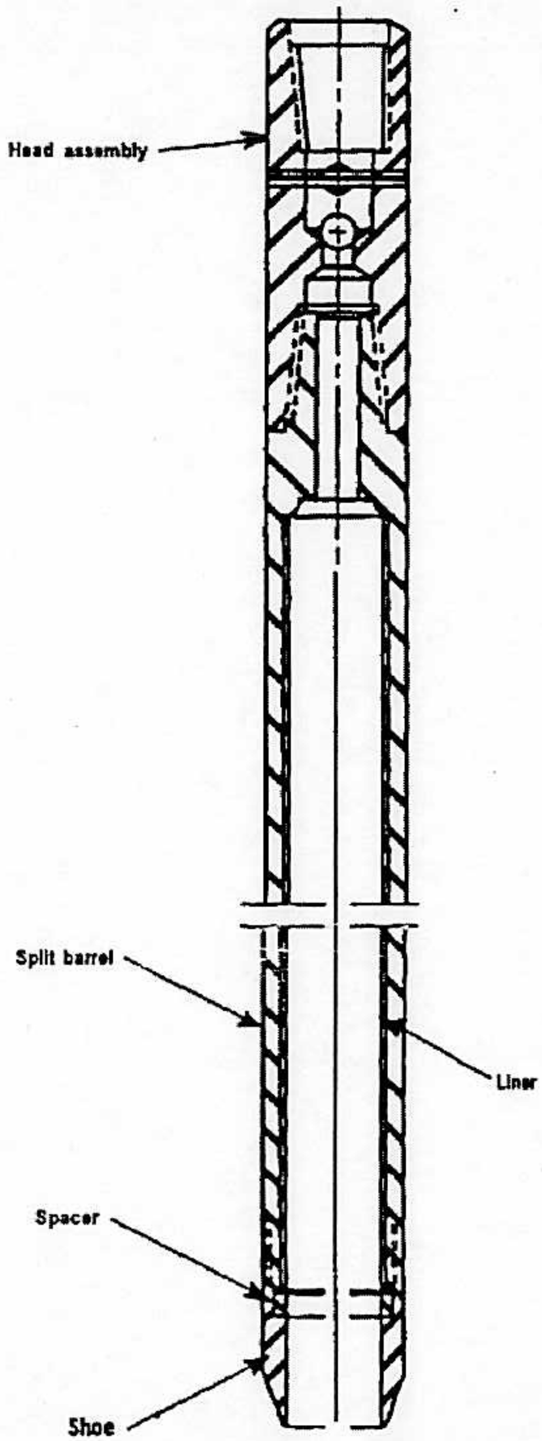
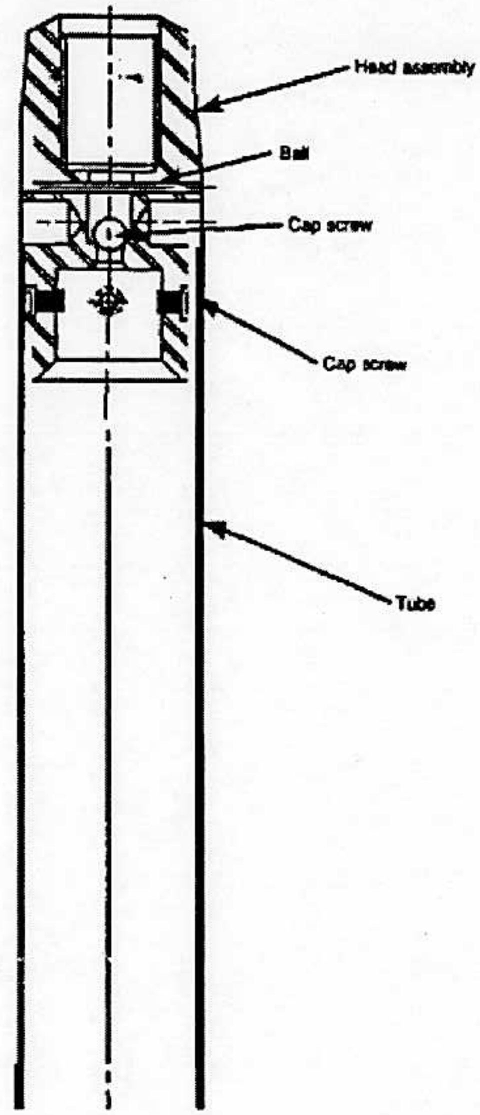


**FIGURE 4**

**THIN-WALL TUBE SAMPLER**



**SOP APPROVAL FORM**

**THE PRESIDIO TRUST**

**ENVIRONMENTAL STANDARD OPERATING PROCEDURE**

**GROUNDWATER SAMPLING**

**SOP NO. 002**

**REVISION NO. 00**

Last Reviewed: December 2000

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12 JAN 01

Date

## 1.0 BACKGROUND

Groundwater sampling is conducted where there is a need to examine the chemical composition of groundwater contaminants. Groundwater can be sampled from an exploratory boring, pit or trench but the most reliable chemical data requires sampling from a properly constructed monitoring well. Groundwater sample collection procedures, when using low flow technology, are discussed in standard operating procedure (SOP) No. 003.

### 1.1 PURPOSE

This SOP establishes the requirements and procedures for sampling of groundwater from a properly constructed monitoring well (refer to SOP No. 004 for well installation procedures).

### 1.2 SCOPE

This SOP applies to groundwater sampling activities conducted in the field.

### 1.3 DEFINITIONS

**Bailer:** A cylindrical sampling device with valves on either end used to extract water from a well. Bailers are usually constructed of an inert material such as stainless steel or polytetrafluoroethylene (Teflon®). The bailer is lowered and raised by means of a disposable rope or a cable that may be cleaned and reused.

**Electrical Water Level Indicator:** An electrical device that has a light or sound alarm connected to an open circuit used to determine the depth to fluid. The circuit is closed when the probe intersects a conducting fluid. The wire used to raise and lower the probe is usually graduated in feet and inches.

**Immiscible Phase:** Liquid phases (such as oils) that cannot be uniformly mixed or blended with water. Heavy immiscible phases sink, and light immiscible phases float on water.

**Interface Probe:** An electrical probe that determines the distance from the surface to air/water, air/immiscible liquid, or immiscible liquid/water interfaces.

**Purge Volume:** The volume of water that needs to be removed from the well to ensure that a sample representative of groundwater is taken.

**Riser Pipe:** The length of well casing above the ground surface.

**Total Well Depth:** The distance from the ground surface to the bottom of the well.

**Water Level:** The level of water in a well. Measured as depth to water or as elevation of water, relative to a reference mark or datum (typically a permanent mark etched on the top of the inner casing.

## 1.4 REFERENCES

U.S. Department of Energy. 1985. *Procedures for the Collection and Preservation of Groundwater and Surface Water Samples and for the Installation of Monitoring Wells: Second Edition.* N. Korte and P. Kearl (Editors). Technical Measurements Center, Grand Junction Projects Office. GJ/TMC-08.

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## 1.5 REQUIREMENTS AND RESOURCES

There are various options available to obtain groundwater samples. The procedures are outlined in the following section. The equipment needed to accomplish these procedures includes the following:

- Organic vapor detector with a flame ionization detector (FID) or a photoionization detector (PID)
- Pipe wrench
- Electrical water level indicator or interface probe
- Steel tape with heavy weight
- Purging device (type needed depends on well depth, casing diameter, type of sample desired - see sampling devices below)
- Sampling device (type needed depends upon depth to water and type of sample desired)
  - Bailer
  - Bladder pump

  - Submersible (non-oil-bearing) pump
  - Existing dedicated equipment
  - Peristaltic pump
  - Tubing
- Sample containers
- Wastewater containers
- Field logbook
- Stopwatch

Additional equipment is required to complete measurement of field parameters (for example, pH, specific conductance, and temperature) of the groundwater at the well.

## 2.0 PROCEDURES

Prior to sampling, a project-specific field sampling plan should be developed. The plan should take into consideration the site characteristics and should include:

- The specific repeatable water level measurement techniques and reference points for determining the depth to water and the depth to the bottom of the well
- The specific method of purging and selection of purging equipment
- The specific analytic method for measurements of field parameters and the selection of field analytical equipment
- The specific method of sample collection and selection of sampling equipment
- The order of sample bottle filling
- The sample chemical analytical parameters

The following sections discuss procedures for approaching the well, establishing a sample preparation area, preliminary well measurements, purging the well, and sample collection.

## 2.1 APPROACHING THE WELL

In general, all wells should be assumed to pose a health and safety risk until field measurements indicate otherwise. Approach wells from the upwind side. Record well appearance and general condition of the protective casing, surface seal, and surrounding area in the logbook.

Once at the well, the lead person should systematically use the organic vapor detector to survey the immediate area around the well (from the breathing zone to the top of the casing to the ground). If elevated FID and PID meter readings are encountered, retreat to a safe area and instruct the sampling team to put on the appropriate level of personal protective equipment (PPE).

Upon opening the well casing, the lead person should systematically survey inside the well casing, above the well casing in the breathing zone and the immediate area around the well. If elevated FID or PID meter readings in the breathing zone are encountered (see health and safety plan for action levels), retreat and put on appropriate PPE. It is important to remember that action levels are based on readings in the breathing zone, not within the well casing. Representative organic vapor detector readings will be recorded in the logbook.

## 2.2 ESTABLISHING A SAMPLE PREPARATION AREA

The sample preparation area is generally located upwind or to either side of the well. If elevated readings are encountered using an organic vapor detector, this area should be taped off and the sample preparation area should be located upwind, where ambient readings are found.

## 2.3 PRELIMINARY WELL MEASUREMENTS

Several preliminary well measurements should be made prior to initiating sampling of the well. These include determining water level and total well depth measurements, determining the presence of immiscible phases, and calculating purge volumes. All preliminary measurements will be recorded in the logbook, as they are determined.

### 2.3.1 Water Level and Total Well Depth Measurements

Water level measurements are to be made using an electric water-level indicator. This device sounds an alarm or illuminates a light when the measuring probe touches the water surface, thus closing an electrical circuit. The electric cable supporting the probe is usually graduated in decimal feet and can be read at the

well site directly. Water levels should be read to a precision of 0.01 foot. The distance between the static water level and the marked or notched location at the top of the riser pipe is measured. The height of the riser pipe above ground surface, as obtained from well location survey data, is then subtracted from the total reading to give the depth to static water. To improve the accuracy of the readings, each measurement should be for a series of three readings, and the values averaged. This helps to eliminate any gross measurement errors or errors due to kinks or bends in the wires, which may change the length when the device is raised and lowered.

The total well depth can be measured by using a steel tape with a heavy weight attached to the end. The tape is lowered into the well until resistance is met, indicating that the weight has reached the bottom of the well. The total well depth is then read directly from the steel tape to the 0.01-foot fraction. The distance between the bottom of the well and the marked or notched location on the riser pipe is measured. The height of the riser pipe above the ground surface, as obtained from well survey data, is then subtracted from the total reading to give the depth to the bottom of the well. To improve the accuracy of the readings, the weighted steel tape should be used to make a series of three readings, and the readings averaged.

### 2.3.2 Determining if Immiscible Phases are Present

If immiscible phase liquids are observed during the measurement of water level depth and well depth, additional measurements shall be taken to determine the product thickness. Organic liquids are measured by lowering an interface probe slowly to the surface of the liquid in the well. When the audible alarm sounds, record the depth. If the alarm is continuous, a floating immiscible layer has been detected. To determine the thickness of this layer, continue lowering the probe until the alarm changes to an oscillating signal. The oscillating signal indicates that the probe has detected an aqueous layer. Record this depth as the depth to water and determine the thickness and the volume of the immiscible layer.

Continue lowering the probe into the well to determine if immiscible dense phases (sinkers) are present. If the alarm signal changes from oscillating to a continuous sound, a heavier immiscible layer has been detected; record this depth.

Continue lowering the probe to the bottom of the well and record the total depth. Separate total depth measurements with a steel tape are not necessary when using an interface probe. Calculate and record the sinker phase volume and total water volume in the well. Table 1 is provided to assist in these calculations. If immiscible phases are present, immediately refer to Section 2.5.1 or 2.5.2 of this SOP.

**TABLE 1**

**LIQUID VOLUME IN A 1-FOOT SECTION OF A WELL BORING**

| Well Borehole Diameter ($D_1$) (inches) | Well Casing Diameter ($D_2$) (inches) | Volume of Liquid in 1-Foot Well Section (gallons) |
|---|---|---|
| 7 | 2 | 0.71 |
| 8 | 2 | 0.90 |
| 10 | 4 | 1.68 |
| 12 | 4 | 2.22 |

### 2.3.3 Determination of Purging Volume

If the presence of organic liquids does not need to be determined, determine the depth to water and the total depth of the well as described in Section 2.3.1. Once these measurements have been made and recorded, use Table 1 to calculate the total volume of water in the well. In Table 1, the volume of water in a 1-foot section of a 2-inch-diameter well (8-inch borehole) is 0.90 gallon. This chart can easily be used for any water depth by multiplying the appropriate value in Table 1 by the depth (in feet) of water in the well. This volume is then multiplied by the purging factor to determine purging volume. The minimum purging factor is three borehole volumes but may be superseded by site-specific program requirements, individual well yield characteristics, or stabilization of field parameters measured during purging. Field parameters (for example, pH, specific conductance, and temperature) should be measured before purging and after each well volume. All field parameter data are recorded in the field logbook or field data form.

The volume of water to be purged is based on the following formulae:

$$V = [(AV \times n) + CV] \times L \times CF \times PF$$

$$AV = \frac{\pi}{4} \times (D_1^2 - D_2^2)/144$$

$$CV = \frac{\pi}{4} \times (D_2^2)/144$$

where:

| | | |
|---|---|---|
| V | = | volume of water in the well (gallons) |
| AV | = | annular volume (cubic-feet per foot) |
| CV | = | casing volume (cubic-feet per foot) |
| $D_1$ | = | borehole diameter (inches) |
| $D_2$ | = | well casing diameter (inches) |
| L | = | depth of water in the well (feet) |
| n | = | porosity of filter pack (assumed to be 0.30) |
| CF | = | conversion factor of 7.48 (gallons per cubic-foot) |
| PF | = | purging factor (generally a minimum of 3.00) |

Note that temporary wells with no filter pack should use the casing volume times the purging factor to calculate the required purge volume.

## 2.4 PURGING THE WELL

Representative groundwater samples require that wells are purged prior to sampling. There are two acceptable purging methods, (1) three well volume purging and (2) low-flow purging (refer to SOP No. 003 for the low-flow methods). Well purging can be achieved using a variety of options including:

1. Bailers
2. Bladder pumps
3. Submersible (non-oil-bearing) pumps
4. Existing dedicated equipment, if any
5. Peristaltic pumps

As previously stated, the established minimum purging volume is three borehole volumes. The exception to this standard is in the case of low-yield wells. When purging low-yield wells, purge the well once to dryness. Samples should be collected as soon as the well recovers. When the time required for full recovery exceeds 3 hours, samples should be collected as soon as sufficient volume is available.

The well should be purged until the measured field parameters have been stabilized. If any field parameter has not stabilized, additional purging should be performed. To be considered stable, field parameters should change by no more than the tolerance levels listed on Table 2 between each well volume purged.

**TABLE 2**

**FIELD MEASUREMENT TOLERANCE LEVELS**

| Field Parameter | Tolerance Level |
|---|---|
| pH | 0.1 pH unit |
| Specific Conductance | 10 percent |
| Temperature | 1 °C |

At no time should the purging rate be high enough to cause the groundwater to cascade back into the well, resulting in excessive aeration and potential stripping of volatile constituents.

The actual volume of purged water can be measured using several acceptable methods:

- When bailers are used, the actual volume of each bailer's contents can be measured using a calibrated bucket.
- If a pump is used for purging, the pump rate can be determined by using a bucket of known volume, stopwatch, and the duration of pumping time necessary to purge the known volume.

## 2.5 SAMPLE COLLECTION

The technique used to withdraw a groundwater sample from a well should be selected based on the parameters for which the sample will be analyzed. To ensure that the groundwater samples are representative, it is important to avoid physically altering or chemically contaminating the sample during collection, withdrawal, or containerization. If the samples are to be analyzed for volatile organic compounds, it is critical that air does not become entrained in the water column.

Acceptable sampling devices for all parameters are double check valve stainless steel or Teflon® bailers, bladder pumps, low-flow positive displacement pumps, or for shallow wells, peristaltic pumps. Additional measurements of field parameters should be performed at the time of sampling.

In some cases, it may become necessary to use dedicated equipment already in the well to collect samples. This is particularly true of high volume, deep wells ( greater than 150 feet) where bladder pumps are ineffective and bailing is impractical. If existing equipment must be used, however, determine the make and model of the pump and obtain information on component construction materials from the manufacturer or facility representatives. If an existing pump is to be used for sampling, make sure the flow volume can be reduced so that a reliable sample for volatile organic compounds (VOC) analysis can be taken. Record the specific port, tap, or valve from which the sample is collected.

General sampling procedures include the following:

- Clean sampling equipment should not be placed directly on the ground. Use a plastic drop cloth or feed line from clean reels. Never place contaminated lines back on reels.
- Check the operation of the bailer check valve assemblies to confirm free operation.
- If the bailer cable is to be decontaminated and reused, it must be made of Teflon®-coated stainless steel.
- Lower sampling equipment slowly into the well to avoid degassing the water and damaging the equipment.
- Pump flow rates should be adjusted to eliminate intermittent or pulsed flow. The settings should be determined during the purging operations.
- A separate sample volume should be collected to measure necessary field parameters. Samples should be collected and containerized in the order of the parameters' volatilization sensitivity. Table 3 lists the preferred collection order for some common groundwater parameters.

**TABLE 3**

**ORDER OF PREFERRED SAMPLE COLLECTION**

1. VOC
2. Purgeable organic halogens (POX)
3. Total organic halogens (TOX)
4. Cyanide
5. Extractable organics
6. Purgeable organic carbon (POC)
7. Total metals
8. Dissolved metals
9. Total organic carbon (TOC)
10. Phenols
11. Sulfate and chloride
12. Nitrate and ammonia
13. Radionuclides

Intermediate containers should never be used to prepare VOC samples and should be avoided for all parameters in general. All VOC containers should be filled at a single sampling point or from a single bailer volume.

### 2.5.1 Collection of Light Immiscible Floaters

The approach used when collecting floaters is dependent on the depth to the floating layer and the thickness of that layer. If the thickness of the floater is 2 feet or greater, a bottom-filling valve bailer should be used. Slowly lower the bailer until contact is made with the floater surface, and lower the bailer to a depth less than that of the floater/water interface depth as determined by preliminary measurements with the interface probe.

When the thickness of the floating layer is less than 2 feet, and the depth to the surface of the floating layer is less than 15 feet, a peristaltic pump with tubing can be used to extract a sample.

When the thickness of the floating layer, however, is less than 2 feet and the depth to the surface of the floating layer is beyond the effective "lift" of a peristaltic pump (greater than 25 feet), a bailer can be modified to allow filling from the top only (an acceptable alternative is to use a top-loading Teflon® or stainless-steel bailer). Disassemble the bailer's bottom check valve and insert a piece of 2-inch diameter Teflon® sheet between the ball and ball seat. This will seal off the bottom valve. Remove the ball from the top check valve, thus allowing the sample to enter from the top. To overcome buoyancy when the bailer is lowered into the floater, place a length of one-inch stainless steel pipe on the retrieval line above the bailer (this pipe may have to be notched to allow sample entry if the pipe remains within the top of the bailer). Or, as an alternative, use a top-loading stainless-steel bailer. Lower the device, carefully measuring the depth to the surface of the floating layer, until the top of the bailer is level with the top of the floating layer. Lower the bailer an additional one-half thickness of the floating layer and collect the sample. This technique is the most effective method of collection if the floating layer is only a few inches thick. Note that immiscible layers must be collected before any purging activities.

### 2.5.2 Collection of Heavy Immiscible Sinkers

The best method for collection of sinkers is use of a double check valve bailer. The key to collection is controlled, slow lowering and raising of the bailer to and from the bottom of the well. Collection methods are equivalent to those described in Section 2.5.1 above.

### 2.5.3 Collection of Volatile Organics Samples

This section discussesin detail the collection of samples for VOC analysis using either a bailer or bladder pump. Other pumps (such as positive displacement or peristaltic) can be used. Critical factors to the collection of representative VOC samples include ensuring that no air becomes entrained in the water column, maintaining low pump flow rates (less than 100 milliliter [mL] per minute, if possible), and avoiding flow surges.

#### 2.5.3.1 Collection with Bailers

VOC samples should be collected from the first bailer removed from the well after purging. The most effective approach requires two people. One person should retrieve the bailer from the well and pour its contents into the appropriate number of 40-mL VOC vials, which are held by the second person. Each vial is then capped and inverted. If the sample vial has a bubble, unscrew the cap and add more water, or discard and repeat. The sample is transferred from the bailer to the sample container in a manner to limit the amount of agitation and reduce the loss of volatile organics from the sample. Always fill VOC vials from a single bailer volume. If the bailer is refilled, samples cannot be considered duplicates or splits.

#### 2.5.3.2 Collection with a Bladder Pump

To successfully perform VOC sampling with a bladder pump, the following steps must be completed:

1. Following manufacturer's directions, activate the pump. Full water flow from the discharge tubing will begin after 5 to 15 pumping cycles. These initial pumping cycles are required to purge air from the pump and discharge tubing. The discharge and recharge settings must be manually set and adjusted to pump at optimum flow rates. To activate the bladder, it is best to set the initial cycle at long discharge and recharge rates.

2. Reduce the water flow rate for VOC sample collection. To reduce the water flow rate, turn the throttle control valve (located on the left side of the pump control panel) counterclockwise.

3. Collect a VOC sample from discharge tubing. VOC vials must be placed beneath the discharge tubing while avoiding direct contact between the vials and the tubing. <u>Never</u> place tubing past the mouth of the VOC vial. The pump throttle control must be turned as necessary to maintain a trickle of water in order to obtain a meniscus in the vial.

4. Continue with non-VOC sampling. Increase pump flow rate by turning the throttle control knob clockwise.

# ATTACHMENT A
# MONITORING WELL SAMPLING LOG

# MONITORING WELL SAMPLING LOG

THE PRESIDIO TRUST

Well No.: MWO No.:________ Day/Date:______________

Site/Project Name:____________________________________________

**Organic Vapor Concentrations** Top of Casing:______ppm Breathing Zone______ppm

Depth to bottom: [ ] ft. below top of casing

Depth to water: [ ] ft. below top of casing

**Initial D.O. Readings**

Position in Screened Interval

Top: ______mg/L

Middle: ______mg/L

Bottom: ______mg/L

| | Water Column | | Purge Volume | |
|---|---|---|---|---|
| [ ] 2-inch well | | ft. x 0.163 gal/ft x 3 = | | gal. |
| [ ] 4-inch well | | ft. x 0.652 gal/ft x 3 = | | gal. |
| [ ] _-inch well | | ft. x _____ gal/ft x 3 = | | gal. |

Method of Extraction: [ ] Disposable Bailer [ ] Other:________________

**Groundwater Parameters**

| Time | Volume Purged (gal.) | Temp. (°C) | Specific Conductivity (mS/cm) | Salinity (ppt) | Dissolved Oxygen (mg/L) | pH | Turbidity (NTU) | Other |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

Purged Dry? [ ] Field measurement equipment used: ________________________________

**Groundwater Samples Collected**

| **Analytes of Concern** | | | **Fate and Transport Data** | | | | |
|---|---|---|---|---|---|---|---|
| *Off-Site Lab* | | | *Off-Site Lab* | | *Field Test Kit Analyses* | | |
| Metals | | -Filtered | Anions | | Alkalinity | | |
| PCBs | | | M/E/E | | $Fe^{2+}$ | | F-y/n [ ] |
| SVOCs | | | Sulfide | | $Mn^{2+}$ | | F-y/n [ ] |
| TPH-e | | | TDS | | | | |
| TPH-p | | | VOCs | | F-y/n= note (yes/no) filtered samples. | | |
| VOCs | | | | | Filter where turbidity > 100 NTU. | | |

Sampler(s):____________________________________________

Sample Number(s):______________________ Sample Date/Time:__________________

Sample Collection Method: [ ] Disposable Bailer [ ] Other:

QA/QC Sample(s)? [ ] None [ ] Field Duplicate [ ] MS/MSD

Dup. Sample Number:______________________ Dup. Sample Date/Time:______________

Comments:

Sheet ___ of ___

## 1.0 BACKGROUND

All nondisposable field equipment must be decontaminated before and after each use at each sampling location to obtain representative samples and to reduce the possibility of cross-contamination.

### 1.1 PURPOSE

This standard operating procedure (SOP) establishes the requirements and procedures for decontaminating equipment in the field.

### 1.2 SCOPE

This SOP applies to decontaminating general nondisposable field equipment. To prevent contamination of samples, all sampling equipment must be thoroughly cleaned prior to each use.

### 1.3 DEFINITIONS

**Nonphosphate soap:** Alconox® and Liquinox® are common laboratory grade products

### 1.4 REFERENCES

U.S. Environmental Protection Agency (EPA). 1992. "RCRA Groundwater Monitoring: Draft Technical Guidance." Office of Solid Waste and Emergency Response. Washington, DC. EPA/530-R-93-001. November.

EPA. 1994. "Sampling Equipment Decontamination." Environmental Response Team SOP No. 2006. Revision No. 0.0. August 11. (On-Line Address: http://www.ert.org/media_resrcs/media_resrcs.asp.)

### 1.5 REQUIREMENTS AND RESOURCES

The equipment required to conduct decontamination is as follows:

- Scrub brushes
- Large wash tubs or buckets
- Squirt bottles
- Nonphosphate soap
- Tap water

- Distilled water
- Plastic sheeting
- Aluminum foil
- Methanol or hexane
- Dilute (0.1 N) nitric acid
- Steam cleaner

## 2.0 PROCEDURES

The procedures below discuss decontamination of personal protective equipment (PPE), drilling and monitoring well installation equipment, borehole soil sampling equipment, water-level measurement equipment, and general sampling equipment.

### 2.1 PERSONAL PROTECTIVE EQUIPMENT DECONTAMINATION

Personnel working in the field are required to follow specific procedures for decontamination prior to leaving the work area so that contamination is not spread off-site or to clean areas. All used disposable protective clothing, such as Tyvek® coveralls, gloves, and booties, will be containerized for later disposal. Decontamination water will be containerized in 55-gallon drums.

Personnel decontamination procedures will be as follows:

1. Wash neoprene boots (or neoprene boots with disposable booties) with Liquinox or Alconox solution and rinse with clean water. Remove booties and retain boots for subsequent reuse.

2. Wash outer gloves in Liquinox® or Alconox® solution and rinse in clean water. Remove outer gloves and place into plastic bag for disposal.

3. Remove Tyvek® or coveralls. Containerize Tyvek® for disposal and place coveralls in plastic bag for reuse.

4. Remove air purifying respirator (APR), if used, and place the spent filters into a plastic bag for disposal. Filters should be changed daily or sooner depending on use and application. Place respirator into a separate plastic bag after cleaning and disinfecting.

5. Remove disposable gloves and place them in plastic bag for disposal.

6. Thoroughly wash hands and face in clean water and soap.

## 2.2 DRILLING AND MONITORING WELL INSTALLATION EQUIPMENT DECONTAMINATION

All drilling equipment should be decontaminated before drilling operations begin, between borings, and at completion of the project. The locations for decontamination activities will be designated by the Trust project manager.

Monitoring well casing, screens, and fittings are assumed to be delivered to the site in a clean condition. However, they should be steam cleaned on-site prior to placement downhole. The drilling subcontractor will typically furnish the steam cleaner and water.

After cleaning the drilling equipment, field personnel should place the drilling equipment, well casing and screens, and any other equipment that will go into the hole on clean polyethylene sheeting. The drilling auger, bits, drill pipe, temporary casing, surface casing, and other equipment should be decontaminated by the drilling subcontractor by hosing down with a steam cleaner until thoroughly clean. Drill bits and tools that still exhibit particles of soil after the first washing should be scrubbed with a wire brush and then rinsed again with a high-pressure steam rinse.

All wastewater from decontamination procedures should be containerized.

## 2.3 BOREHOLE SOIL SAMPLING EQUIPMENT DECONTAMINATION

The soil sampling equipment should be decontaminated after each sample as follows:

1. Prior to sampling, scrub the split-barrel sampler and sampling tools in a bucket, containing Liquinox® or Alconox® solution, using a stiff, long bristle brush.
2. Steam clean the sampling equipment over the rinsate tub and allow to air dry or rinse with deionized (distilled) water.
3. Place cleaned equipment in a clean area on plastic sheeting and wrap with aluminum foil.
4. Containerize all water and rinsate.
5. Decontaminate all pipe placed down the hole as described for drilling equipment.

## 2.4 WATER-LEVEL MEASUREMENT EQUIPMENT DECONTAMINATION

Field personnel should decontaminate the well sounder and interface probe before inserting and after removing them from each well. The following decontamination procedures should be used:

1. Wipe the sounding cable with a disposable soap-impregnated cloth or paper towel.

2. Rinse with deionized (distilled) organic-free water.

## 2.5 GENERAL SAMPLING EQUIPMENT DECONTAMINATION

All nondisposable sampling equipment should be decontaminated using the following procedures:

1. Select an area removed from sampling locations that is both downwind and downgradient. Decontamination must not cause cross-contamination between sampling points.

2. Maintain the same level of protection as was used for sampling.

3. If a steam cleaner is not available, to decontaminate a piece of equipment, use an Alconox® wash; a tap water wash; a solvent (methanol or hexane) rinse, if applicable or dilute (0.1 N) nitric acid rinse, if applicable; a distilled water rinse; and air drying. Use a solvent (methanol or hexane) rinse for grossly contaminated equipment (for example, equipment that is not readily cleaned by the Alconox® wash). The dilute nitric acid rinse may be used if metals are the analyte of concern.

4. Place cleaned equipment in a clean area on plastic sheeting and wrap with aluminum foil.

5. Containerize all water and rinsate.

## 1.0 BACKGROUND

In any sampling program, the integrity of a sample must be ensured from its point of collection to its final disposition. Procedures for classifying, packaging, and shipping samples are described below. Steps in the procedures should be followed to ensure sample integrity and to protect the welfare of persons involved in shipping and receiving samples. When hazardous substances and dangerous goods are sent by common carrier, their packaging, labeling, and shipping are regulated by the U.S. Department of Transportation (DOT) Hazardous Materials Regulations (HMR) (*Code of Federal Regulations*, Title 49 [49 CFR] Parts 106 through 180) and the International Air Transportation Association (IATA) Dangerous Goods Regulations (DGR).

### 1.1 PURPOSE

This standard operating procedure (SOP) establishes the requirements and procedures for packaging and shipping samples. It has been prepared in accordance with the U.S. Environmental Protection Agency (EPA) "Sampler's Guide to the Contract Laboratory Program (CLP)," the DGR, and the HMR. Sample packaging and shipping procedures described in this SOP should be followed for all sample packaging and shipping. Deviations from the procedures in this SOP must be documented in a field logbook. This SOP assumes that samples are already collected in the appropriate sample jars and that the sample jars are labeled and tagged appropriately.

### 1.2 SCOPE

This SOP applies to sample classification, packaging, and shipping.

### 1.3 DEFINITIONS

**Chain of Custody:** Document indicating custody of the samples at all times between sampling and analysis.

**Custody Seal:** A custody seal is a tape-like seal. Placement of the custody seal is part of the chain-of-custody process and is used to prevent tampering with samples after they have been packaged for shipping.

**Dangerous Goods:** Dangerous goods are articles or substances that can pose a significant risk to health, safety, or property when transported by air; they are classified as defined in Section 3 of the DGR (IATA 1999).

**Environmental Samples:** Environmental samples include drinking water, groundwater and surface water, soil, sediment, treated municipal and industrial wastewater effluent, and biological specimens. Environmental samples typically contain low concentrations of contaminants and when handled require only limited precautionary procedures.

**Hazardous Materials Regulations:** The HMRs are DOT regulations for the shipment of hazardous materials by air, water, and land; they are located in 49 CFR 106 through 180.

**Hazardous Samples:** Hazardous samples include dangerous goods and hazardous substances. Hazardous samples shipped by air should be packaged and labeled in accordance with procedures specified by the DGR; ground shipments should be packaged and labeled in accordance with the HMR.

**Hazardous Substance:** A hazardous substance is any material, including its mixtures and solutions, that is listed in Appendix A of 49 CFR 172.101 and its quantity, in one package, equals or exceeds the reportable quantity (RQ) listed in the appendix.

**IATA Dangerous Goods Regulations:** The DGRs are regulations that govern the international transport of dangerous goods by air. The DGRs are based on the International Civil Aviation Organization (ICAO) Technical Instructions. The DGR contain all of the requirements of the ICAO Technical Instructions and are more restrictive in some instances.

**Nonhazardous Samples:** Nonhazardous samples are those samples that do not meet the definition of a hazardous sample and **do not** need to be packaged and shipped in accordance with the DGR or HMR.

**Overpack:** An enclosure used by a single shipper to contain one or more packages and to form one handling unit (IATA 1999). For example, a cardboard box may be used to contain three fiberboard boxes to make handling easier and to save on shipping costs.

## 1.4 REFERENCES

U.S. Department of Transportation, Transport Canada, and the Secretariat of Communications and Transportation of Mexico (DOT and others). 1996. *1996 North American Emergency Response Guidebook.*

International Air Transport Association (IATA). 1997. *Guidelines for Instructors of Dangerous Courses.*

IATA. 1999. *Dangerous Goods Regulations.* 40th Edition.

U.S. Environmental Protection Agency. 1994. "Sampler's Guide to the Contract Laboratory Program." Office of Solid Waste and Emergency Response. Washington, DC. EPA/540/R-96/032. On-Line Address: http://www.epa.gov/oerrpage/superfund/programs/clp/guidance.htm - sample

## 1.5 REQUIREMENTS AND RESOURCES

The procedures for packaging and shipping **nonhazardous** samples require the following:

- Coolers
- Ice
- Vermiculite, bubble wrap, or similar cushioning material
- Chain-of-custody forms and seals
- Airbills
- Resealable plastic bags for sample jars and ice
- Tape (strapping and clear)

The procedures for packaging and shipping **hazardous** samples require the following:

- Ice
- Vermiculite or other noncombustible, absorbent packing material
- Chain-of-custody forms and seals
- Appropriate dangerous goods airbills and emergency response information to attach to the airbill
- Resealable plastic bags for sample jars and ice

- Tape (strapping and clear)
- Appropriate shipping containers, as specified in the DGR
- Labels that apply to the shipment such as hazard labels, address labels, "Cargo Aircraft Only" labels, and package orientation labels (up arrows)

## 2.0 PROCEDURES

The following procedures apply to packing and shipping nonhazardous and hazardous samples.

### 2.1 SAMPLE CLASSIFICATION

Prior to sample shipment by air courier, it must be determined whether the sample is subject to the DGR. Samples subject to these regulations shall be referred to as hazardous samples. Any airline belonging to IATA must follow the DGR. As a result, these air carriers **may not** accept a shipment that is packaged and labeled in accordance with the HMR (although in most cases, the packaging and labeling would be the same for either set of regulations). The HMR states that a hazardous material may be transported by aircraft in accordance with the ICAO Technical Instruction (49 CFR 171.11) upon which the DGR is based. Therefore, the use of the DGR for samples to be shipped by air complies with the HMR, but not vice versa.

Most environmental samples are not hazardous samples and do not need to be packaged in accordance with any regulations. Hazardous samples are those samples that can be classified as specified in Section 3 of the DGR, can be found in the List of Dangerous Goods in the DGR in bold type, are considered a hazardous substance (see definition), or are mentioned in "Section 2 - Limitations" of the DGR for countries of transport or airlines (such as FedEx). The hazard classifications specified in the DGR (and the HMR) are as follows:

Class 1 – Explosives

Division 1.1 – Articles and substances having a mass explosion hazard
Division 1.2 – Articles and substances having a projection hazard but not a mass explosion hazard
Division 1.3 – Articles and substances having a fire hazard, a minor blast hazard, and/or a minor projection hazard but not a mass explosion hazard
Division 1.4 – Articles and substances presenting no significant hazard
Division 1.5 – Very sensitive substances mass explosion hazard

Division 1.6 – Extremely insensitive articles, which do not have a mass explosion hazard

Class 2 – Gases

Division 2.1 – Flammable gas
Division 2.2 – Nonflammable, nontoxic gas
Division 2.3 – Toxic gas

Class 3 – Flammable Liquids

Class 4 – Flammable Solids; Substances Liable to Spontaneous Combustion; Substances, when in Contact with Water, Emit Flammable Gases

Division 4.1 – Flammable solids
Division 4.2 – Substances liable to spontaneous combustion
Division 4.3 – Substances, when in contact with water, emit flammable gases

Class 5 – Oxidizing Substances and Organic Peroxide

Division 5.1 – Oxidizers
Division 5.2 – Organic peroxides

Class 6 – Toxic and Infectious Substances

Division 6.1 – Toxic substances
Division 6.2 – Infectious substances

Class 7 – Radioactive Material

Class 8 – Corrosives

Class 9 – Miscellaneous Dangerous Goods

The criteria for each of the first eight classes are very specific and are outlined in Section 3 of the DGR and 49 CFR 173 of the HMR. Some classes and divisions are further divided into packing groups based on their level of danger. Packing group I indicates a great danger, packing group II indicates a medium danger, and packing group III indicates a minor danger. Class 2, gases, includes any compressed gas being shipped and any noncompressed gas that is either flammable or toxic. A compressed gas is defined as having a pressure over 40 pounds per square inch (psi) absolute (25 psi gauge). Most air samples and empty cylinders that did not contain a flammable or toxic gas are exempt from the regulations. An empty hydrogen cylinder, as in a flame ionization detector (FID), is considered a dangerous good unless it is properly purged with nitrogen in accordance with the HMR. A landfill gas sample is usually considered a

flammable gas because it may contain a high percentage of methane. Class 3, flammable liquids, are based on the boiling point and flash point of a substance. Most class 3 samples include solvents, oil, gas, or paint-related material collected from drums, tanks, or pits. Division 6.1, toxic substances, is based on oral toxicity ($LD_{50}$ [lethal dose that kills 50 percent of the test animals]), dermal toxicity ($LD_{50}$ values), and inhalation toxicity ($LC_{50}$ [lethal concentration that kills 50 percent of the test animals] values). Division 6.1 substances include pesticides and cyanide. Class 7, radioactive material, is defined as any article or substance with a specific activity greater than 70 kiloBecquerels (kBq/kg) (0.002 [microCuries per gram [µCi/g]). If the specific activity exceeds this level, the sample should be shipped in accordance with Section 10 of the DGR. Class 8, corrosives, is based on the rate at which a substance destroys skin tissue or corrodes steel; they are not based on pH. Class 8 materials include the concentrated acids used to preserve water samples. Preserved water samples are not considered class 8 substances and should be packaged as nonhazardous samples. Class 9, miscellaneous dangerous goods, is substances that present a danger, but are not covered by any other hazard class. Examples of class 9 substances include asbestos, polychlorinated biphenyls (PCB), and dry ice.

Unlike the DGR, the HMR includes combustible liquids in hazard class 3. The definition of a combustible liquid is specified in 49 CFR 173.120 of the HMR. The HMR has an additional class, ORM-D, which is not specified in the DGR. "ORM-D material" refers to a material such as a consumer commodity, which although otherwise subject to the HMR, presents a limited hazard during transport due to its form, quantity, and packaging. It must be a material for which exceptions are provided in the table of 49 CFR 172.101. The DGR lists consumer commodities as a class 9 material.

In most instances, the hazard of a material sampled is unknown because no laboratory testing has been conducted. A determination as to the suspected hazard of the sample must be made using knowledge of the site, field observations, field tests, and other available information.

According to 40 CFR 261.4(d) and (e), samples transported to a laboratory for testing or treatability studies, including samples of hazardous wastes, are **not** hazardous wastes. Air carriers will not accept a shipment of hazardous waste.

## 2.2 PACKAGING NONHAZARDOUS SAMPLES

Nonhazardous samples, after being appropriately containerized, labeled, and tagged, should be packaged in the following manner.

1. Place the sample in a resealable plastic bag.

2. Place the bagged sample in a cooler and pack it to prevent breakage.

3. Prevent breakage of bottles during shipment by either wrapping the sample container in bubble wrap, or lining the cooler with a noncombustible material such as vermiculite. Vermiculite is especially recommended because it will absorb any free liquids inside the cooler. It is recommended that the cooler be lined with a large plastic garbage bag before samples, ice, and absorbent packing material are placed in the cooler.

4. Add a sufficient quantity of ice to the cooler to cool samples to 4 °C. Ice should be double bagged in resealable plastic bags to prevent the melted ice from leaking out. As an option, a temperature blank (a sample bottle filled with distilled water) can be included with the cooler.

5. Seal the completed chain-of-custody forms in a plastic bag and tape the plastic bag to the inside of the cooler lid.

6. Tape any instructions for returning the cooler to the inside of the lid.

7. Close the lid of the cooler and tape it shut by wrapping strapping tape around both ends and hinges of the cooler at least once. Tape shut any drain plugs on the cooler.

8. Place two signed custody seals on the cooler, ensuring that each one covers the cooler lid and side of the cooler. Place clear plastic tape over the custody seals.

9. Place address labels on the outside of the cooler, if samples are to be shipped by a commercial carrier.

## 2.2 PACKAGING HAZARDOUS SAMPLES

Packaging of hazardous samples should only be performed by individuals with DOT shipping training. The procedures for packaging hazardous samples are summarized below. Note that according to the DGR, all spellings must be exactly as they appear in the List of Dangerous Goods, and only approved abbreviations are acceptable. The corresponding HMR regulations are provided in parentheses following any DGR references. The HMR must be followed only if shipping hazardous samples by ground transport.

1. Determine the proper shipping name for the material to be shipped. All proper shipping names are listed in column B of the List of Dangerous Goods table in Section 4 of the DGR (or column 2 of the Hazardous Materials Table in 49 CFR 172.101). In most instances, a generic name based on the hazard class of the material is appropriate. For example, a sample of an oily liquid collected from a drum with a high photoionization detector (PID) reading should be packaged as a flammable liquid. The proper shipping name chosen for this sample would be "flammable liquid, n.o.s." The abbreviation "n.o.s." stands for "not otherwise specified" and is used for generic shipping names. Typically, a specific name, such as acetone, should be inserted in parentheses after most n.o.s. descriptions. However, a technical name is not required when shipping a sample for testing purposes and the components are not known. If shipping a hazardous substance (see definition), then the letters "RQ" must appear in front of the proper shipping name.

2. Determine the United Nations (UN) identification number, class or division, subsidiary risk if any, required hazard labels, packing group, and either passenger aircraft or cargo aircraft packing instructions based on the quantity of material being shipped in one package. This information is provided in the List of Dangerous Goods (or Hazardous Materials Table in 49 CFR 172.101) under the appropriate proper shipping name. A "Y" in front of a packing instruction indicates a limited quantity packing instruction. If shipping dry ice or a limited quantity of a material, then UN specification shipping containers do not need to be used.

3. Determine the proper packaging required for shipping the samples. Except for limited quantity shipments and dry ice, these UN specification packages have been tested to meet the packing group of the material being shipped. Specific testing requirements of the packages are listed in Section 6 of the DGR (or 49 CFR 178 of the HMR). All UN packages are stamped with the appropriate UN specification marking. Prior planning is required to have the appropriate packages on hand during a sampling event where hazardous samples are anticipated. Most samples can be shipped in either a 4G fiberboard box, a 1A2 steel drum, or a 1H2 plastic drum. Drums can be purchased in 5- and 20-gallon sizes and are ideal for shipping multiple hazardous samples. When FedEx is used to ship samples containing PCBs, the samples must be shipped in an inner metal packaging (paint can) inside a 1A2 outer steel drum. This method of packaging PCB samples is in accordance with FedEx variation FX-06, listed in Section 2 of the DGR.

4. Place each sample jar in a separate resealable plastic bag. Some UN specification packages contain the sample jar and plastic bag to be used when shipping the sample.

5. Place each sealed bag inside the approved UN specification container (or other appropriate container if a limited quantity or dry ice) and pack with enough noncombustible, absorbent, cushioning material (such as vermiculite) to prevent breakage and to absorp liquid.

6. Place chain-of-custody forms in a resealable plastic bag and either attach it to the inside lid of the container or place it on top inside the container. Place instructions for returning the container to the shipper on the inside lid of the container as appropriate. Close and seal the shipping container in the manner appropriate for the type of container being used.

7. Label and mark each package appropriately. All irrelevant markings and labels need to be removed or obliterated. All outer packaging must be marked with proper shipping name, UN identification number, and name and address of the shipper and the recipient. For carbon dioxide, solid (dry ice), the net weight of the dry ice within the package needs to be marked on the outer package. For limited quantity shipments, the words "limited quantity" or "LTD. QTY." must be marked on the outer package. Affix the appropriate hazard label to the outer package. If the material being shipped contains a subsidiary hazard, then a subsidiary hazard label must also be affixed to the outer package. The subsidiary hazard label is identical to the primary hazard label except that the class or division number is not present. It is acceptable to obliterate the class or division marking on a primary hazard label and use it as the subsidiary hazard label. If using cargo aircraft only packing instructions, then the "Cargo Aircraft Only" label must be used. Package orientation labels (up arrows) must be placed on opposite sides of the outer package. Figure 1 depicts a properly marked and labeled package.

8. If using an overpack (see definition), mark and label the overpack and each outer packaging within the overpack as described in step 7. In addition, the statement "INNER PACKAGES COMPLY WITH PRESCRIBED SPECIFICATIONS" must be marked on the overpack.

9. Attach custody seals, and fill out the appropriate shipping papers as described in Section 2.4.

## 2.4 SHIPPING PAPERS FOR HAZARDOUS SAMPLES

A "Shippers Declaration for Dangerous Goods" and "Air Waybill" must be completed for each shipment of hazardous samples. Air carriers generally supply a their own Dangerous Goods Airbill to their customers; the airbill typically combines both the declaration and the waybill. An example of a completed Dangerous Goods Airbill is depicted in Figure 2. A shipper's declaration must contain the following:

- Name and address of shipper and recipient
- Air waybill number (not applicable to the HMR)
- Page ___ of ___
- Deletion of either "Passenger and Cargo Aircraft" or "Cargo Aircraft Only," whichever does not apply
- Airport or city of departure
- Airport or city of destination
- Deletion of either "Non-Radioactive" or "Radioactive," which ever does not apply

- The nature and quantity of dangerous goods. This includes the following information in the following order (obtained from the List of Dangerous Goods in the DGR): proper shipping name, class or division number, UN identification number, packing group number, subsidiary risk, quantity in liters or kilograms (kg), type of packaging used, packing instructions, authorizations, and additional handling information. Authorizations include the words "limited quantity" or "LTD. QTY." if shipping a limited quantity, any special provision numbers listed in the List of Dangerous Goods in the DGR, and the variation "USG-14" when a technical name is required after the proper shipping name but not entered because it is unknown.

- Signature for the certification statement

- Name and title of signatory

- Place and date of signing certification

- A 24-hour emergency response telephone number for use in the event of an incident involving the dangerous good

- Emergency response information attached to the shipper's declaration. This information can be in the form of a material safety data sheet or the applicable North American Emergency Response Guidebook (NAERG; DOT 1996) pages. Figure 3 depicts the appropriate NAERG emergency response information for "Flammable liquids, n.o.s." as an example.

Note that dry ice does not require an attached shipper's declaration. However, the air waybill must include the following on it: "Dry ice, 9, UN1845, ____ x ____ kg." The blanks must include the number of packages and the quantity in kg in each package. If using FedEx to ship dry ice, the air waybill includes a box specifically for dry ice. Simply check the appropriate box and enter in the number of packages and quantity in each package.

The HMR requirements for shipping papers are located in 49 CFR 172 Subpart C.

## 3.0 POTENTIAL PROBLEMS

The following potential problems may occur during sample shipment:

- Leaking package. If a package leaks, the carrier may open the package, return the package, and if a dangerous good, inform the Federal Aviation Administration (FAA), which can result in fines.

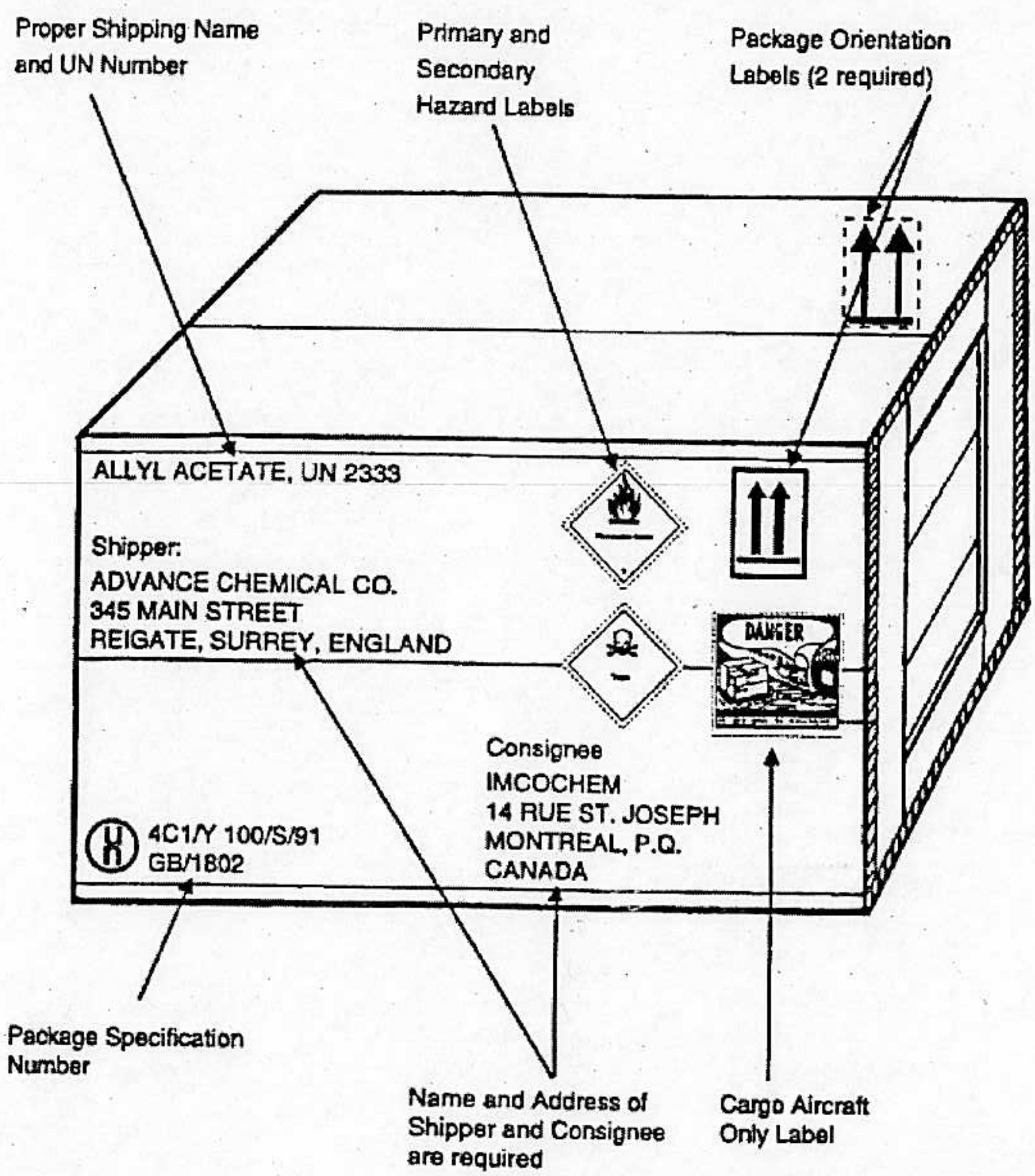
- Improper labeling and marking of package. If mistakes are made in labeling and marking the package, the carrier will most likely notice the mistakes and return the package to the shipper, thus delaying sample shipment.

- Improper, misspelled, or missing information on the shipper's declaration. The carrier will most likely notice this as well and return the package to the shipper.

Contact the air carrier with questions about dangerous goods shipments and ask for a dangerous goods expert.

**FIGURE 1**

**EXAMPLE OF A CORRECTLY MARKED AND LABELED DANGEROUS GOODS PACKAGE**




Source: International Air Transport Association (IATA). 1997.

## FIGURE 2

## EXAMPLE OF A DANGEROUS GOODS AIRBILL

FedEx *Dangerous Goods Airbill*

Senders Copy
RETAIN THIS COPY FOR YOUR RECORDS

11729489

**1 From** Please print and press hard

Date: FILL IN
Sender's FedEx Account Number: 1788-8C14-4

Sender's Name: FILL IN
Phone: (312) 856 8700

Company: TETRA TECH EM INC

Address: 200 E RANDOLPH ST STE 4700

City: CHICAGO State: IL ZIP: 60601

**2** Your Internal Billing Reference: FILL IN

**3 To**

Recipient's Name: FILL IN
Phone: ( )

Company

Address

City State ZIP

For HOLD at FedEx Location check here: Hold Weekday / Hold Saturday

For WEEKEND Delivery check here: Saturday Delivery / Sunday Delivery

**4a Express Package Service** Packages up to 150 lbs.
☒ FedEx Priority Overnight ☐ FedEx Standard Overnight ☐ FedEx 2Day ☐ FedEx Express Saver

**4b Express Freight Service** Packages over 150 lbs.
☐ FedEx 1Day Freight ☐ FedEx 2Day Freight ☐ FedEx 3Day Freight

*The World On Time.*

Questions? Call 1·800·Go·FedEx® (800-463-3339) or Visit our Web site at www.fedex.com

**5 Packaging**
☒ Other Packaging
Dangerous Goods cannot be shipped in FedEx packaging.

**6 Special Handling**
☒ Dangerous Goods as per attached Shipper's Declaration
☐ Cargo Aircraft Only

**7 Payment**
Bill to: ☒ Sender ☐ Recipient ☐ Third Party ☐ Credit Card ☐ Cash/Check

Total Packages | Total Weight | Total Declared Value $ .00

Signature Release Unavailable

374

FedEx Tracking Number: 813350883058 0204

Page 1 of 1 Pages

*Two completed and signed copies of this Declaration must be handed to the operator.*

**WARNING**
**Failure to comply in all respects with the applicable Dangerous Goods Regulations may be in breach of the applicable law, subject to legal penalties. This Declaration must not, in any circumstances, be completed and/or signed by a consolidator, a forwarder or an IATA cargo agent.**

**TRANSPORT DETAILS**
This shipment is within the limitations prescribed for: (delete non-applicable) PASSENGER AND CARGO AIRCRAFT / ~~CARGO AIRCRAFT ONLY~~

Airport of Departure: Chicago

Airport of Destination: "City sending sample to"

Shipment type: (delete non-applicable) NON-RADIOACTIVE ~~RADIOACTIVE~~

**NATURE AND QUANTITY OF DANGEROUS GOODS**

| Proper Shipping Name | Class or Division | UN or I.D. No. | Packing Group | Subsidiary Risk | Quantity and Type of Packaging | Packing Inst. | Authorization |
|---|---|---|---|---|---|---|---|
| Flammable liquid, n.o.s. | 3 | UN 1993 | III | — | 4 glass jars in a 1A2 steel drum<br>Net Quantity = 4L | 309 | A3<br>USG-14 |

Additional Handling Information: NAERG# 128 Attached.

Prepared for AIR TRANSPORT according to: (Customer MUST check one) ☐ 49 CFR ☒ ICAO/IATA

I hereby declare that the contents of this consignment are fully and accurately described above by the proper shipping name and are classified, packaged, marked, and labeled/placarded, and are in all respects in proper condition for transport according to applicable international and national governmental regulations.

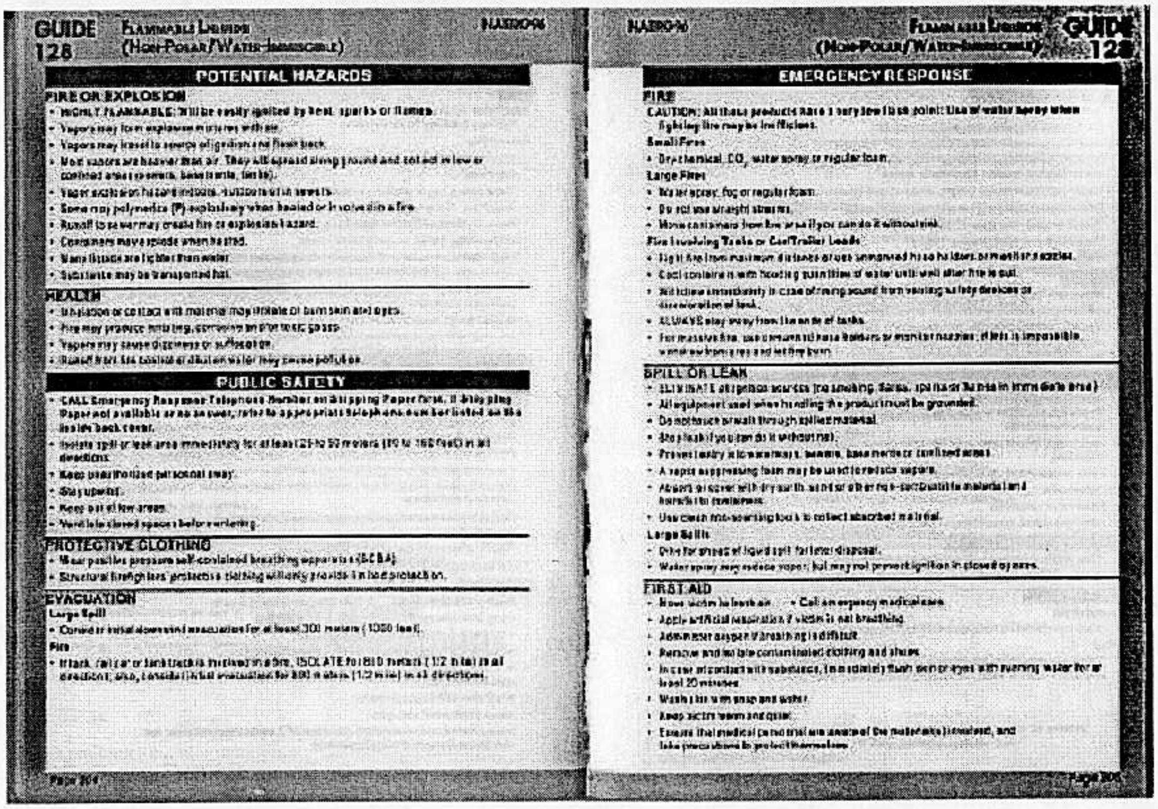
Name/Title of Signatory: me, Environmental Scientist
Place and Date: 200 E Randolph, Chicago, IL xx/xx/xx
Signature: me

Emergency Telephone Number (Required for U.S. Origin or Destination Shipments): FILL IN

IF ACCEPTABLE FOR PASSENGER AIRCRAFT THIS SHIPMENT CONTAINS RADIOACTIVE MATERIAL INTENDED FOR USE IN, OR INCIDENT TO, RESEARCH, MEDICAL DIAGNOSIS, OR TREATMENT.

## FIGURE 3

## NAERG EMERGECY RESPONSE INFORMATION FOR FLAMMABLE LIQUIDS, N.O.S.



GUIDE 128 FLAMMABLE LIQUIDS (NON-POLAR/WATER-IMMISCIBLE) NAERG96

**POTENTIAL HAZARDS**

**FIRE OR EXPLOSION**

- HIGHLY FLAMMABLE: Will be easily ignited by heat, sparks or flames.
- Vapors may form explosive mixtures with air.
- Vapors may travel to source of ignition and flash back.
- Most vapors are heavier than air. They will spread along ground and collect in low or confined areas (sewers, basements, tanks).
- Vapor explosion hazard indoors, outdoors or in sewers.
- Some may polymerize (P) explosively when heated or involved in a fire.
- Runoff to sewer may create fire or explosion hazard.
- Containers may explode when heated.
- Many liquids are lighter than water.
- Substance may be transported hot.

**HEALTH**

- Inhalation or contact with material may irritate or burn skin and eyes.
- Fire may produce irritating, corrosive and/or toxic gases.
- Vapors may cause dizziness or suffocation.
- Runoff from fire control or dilution water may cause pollution.

**PUBLIC SAFETY**

- CALL Emergency Response Telephone Number on Shipping Paper first. If Shipping Paper not available or no answer, refer to appropriate telephone number listed on the inside back cover.
- Isolate spill or leak area immediately for at least 25 to 50 meters (80 to 160 feet) in all directions.
- Keep unauthorized personnel away.
- Stay upwind.
- Keep out of low areas.
- Ventilate closed spaces before entering.

**PROTECTIVE CLOTHING**

- Wear positive pressure self-contained breathing apparatus (SCBA).
- Structural firefighters' protective clothing will only provide limited protection.

**EVACUATION**

**Large Spill**

- Consider initial downwind evacuation for at least 300 meters (1000 feet).

**Fire**

- If tank, rail car or tank truck is involved in a fire, ISOLATE for 800 meters (1/2 mile) in all directions; also, consider initial evacuation for 800 meters (1/2 mile) in all directions.

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NAERG96 FLAMMABLE LIQUIDS (NON-POLAR/WATER-IMMISCIBLE) GUIDE 128

**EMERGENCY RESPONSE**

**FIRE**

CAUTION: All these products have a very low flash point: Use of water spray when fighting fire may be inefficient.

**Small Fires**

- Dry chemical, $CO_2$, water spray or regular foam.

**Large Fires**

- Water spray, fog or regular foam.
- Do not use straight streams.
- Move containers from fire area if you can do it without risk.

**Fire involving Tanks or Car/Trailer Loads**

- Fight fire from maximum distance or use unmanned hose holders or monitor nozzles.
- Cool containers with flooding quantities of water until well after fire is out.
- Withdraw immediately in case of rising sound from venting safety devices or discoloration of tank.
- ALWAYS stay away from the ends of tanks.
- For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn.

**SPILL OR LEAK**

- ELIMINATE all ignition sources (no smoking, flares, sparks or flames in immediate area).
- All equipment used when handling the product must be grounded.
- Do not touch or walk through spilled material.
- Stop leak if you can do it without risk.
- Prevent entry into waterways, sewers, basements or confined areas.
- A vapor suppressing foam may be used to reduce vapors.
- Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers.
- Use clean non-sparking tools to collect absorbed material.

**Large Spills**

- Dike far ahead of liquid spill for later disposal.
- Water spray may reduce vapor; but may not prevent ignition in closed spaces.

**FIRST AID**

- Move victim to fresh air. • Call emergency medical care.
- Apply artificial respiration if victim is not breathing.
- Administer oxygen if breathing is difficult.
- Remove and isolate contaminated clothing and shoes.
- In case of contact with substance, immediately flush skin or eyes with running water for at least 20 minutes.
- Wash skin with soap and water.
- Keep victim warm and quiet.
- Ensure that medical personnel are aware of the material(s) involved, and take precautions to protect themselves.

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Source: DOT and others. 1996.

APPENDIX G

EXAMPLE FIELD FORMS

REVIEWED BY: RR

# APPENDIX G
## Contents

FIELD LOG OF BORING

SHEET ____ OF ____

| LOCATION OF BORING: | PROJECT: | BORING NO. |
|---|---|---|
| | | TOTAL DEPTH: |
| | JOB NO.: | LOGGED BY: |
| | PROJ. MGR.: | EDITED BY: |
| | DRILLING CONTRACTOR: | |
| | DRILL RIG TYPE: | |
| | DRILLERS NAME: | |
| | SAMPLING METHODS: | |
| | HAMMER WT.: | DROP: |
| | STARTED, TIME: | DATE: |
| | COMPLETED, TIME: | DATE: |

| | | | |
|---|---|---|---|
| BORING DEPTH (ft.) | | | |
| CASING DEPTH (ft.) | | | |
| WATER DEPTH (ft.) | | | |
| TIME: | | | |
| DATE: | | | |

BACKFILLED, TIME: DATE: BY:

SURFACE ELEV.: DATUM:

CONDITIONS:

| SAMPLE DEPTH | SAMPLER TYPE | BLOWS/6-IN. | INCHES DRIVEN | INCHES RECOVERED | SAMPLE CONDITION | DRILLING RATE (min/ft) | | | | DEPTH IN FEET | GRAPHIC LOG |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | 1 | |
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FF7

MACTEC

FIELD LOG OF BORING (CONTINUED)

SHEET ____ OF ____

| DEPTH | TYPE | BLOWS | DRIVEN | REC'V'D. | COND. | D.RATE | | | | DEPTH | GRAPHIC LOG | PROJECT: | NO. | BORING NO. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
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| | | | | | | | | | | 0 | | | | |

MACTEC

5341 Old Redwood Highway
Suite 300
Petaluma, CA 94954
(707) 793-3800

# CHAIN OF CUSTODY FORM

Seq. No.: № 1267

Samplers: ______

Lab: ______

Job Number: ______

Name/Location: ______

Project Manager: ______ Recorder: ______ (Signature Required)

| MATRIX | | | # CONTAINERS & PRESERV. | | | | | SAMPLE NUMBER | | DATE | | | | STATION DESCRIPTION | | ANALYSIS REQUESTED |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Water | Soil | Air | Unpres. | H2SO4 | HNO3 | HCL | | YR | SEQ | YR | MO | DAY | TIME | | DEPTH | |

## ADDITIONAL INFORMATION

| SAMPLE NUMBER | | TURNAROUND TIME/ REMARKS |
|---|---|---|
| YR | SEQ | |

## CHAIN OF CUSTODY RECORD

| Relinquished By (Signature) | (Print Name) | (Company) | Date/Time |
|---|---|---|---|
| Received By (Signature) | (Print Name) | (Company) | Date/Time |
| Relinquished By (Signature) | (Print Name) | (Company) | Date/Time |
| Received By (Signature) | (Print Name) | (Company) | Date/Time |
| Relinquished By (Signature) | (Print Name) | (Company) | Date/Time |
| Received By (Signature) | (Print Name) | (Company) | Date/Time |

Method of Shipment:

Sheet ____ of ______

Project: ______________________________ Job No.: ____________

Subject: FIELD INVESTIGATION DAILY REPORT Date: ____________

Equipment Rental: ____________ Company: ____________ To: ____________

Equipment Hours: ____________ F.E. Time from: ________ to: ________ By: ____________

(Outside service and expense record must be attached for any outside costs)

Attachments:

Initial

MACTEC

# GROUNDWATER LEVEL MEASUREMENTS LOG

THE PRESIDIO TRUST

**Circle type of organic vapor meter used:** PID FID

| Well Number | PID/FID Reading (ppm) | Time | Depth to Groundwater (ft.) (three measurements) | | | Depth to Bottom (ft.) | Comments |
|---|---|---|---|---|---|---|---|
| | | | 1st | 2nd | 3rd | | |
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Date: ______________

Field Staff: ______________ Field Staff Signature: ______________

Page No.: ________

MACTEC

# GROUNDWATER SAMPLING FORM

Job Name: ______________________

Job Number: ______________________

Recorded By: ______________________ (Signature)

Well Number: ______________________

Well Type: ☐ Monitor ☐ Extraction ☐ Other ___

☐ PVC ☐ St. Steel ☐ Other ___

Date: ______________________

Sampled By: ______________________ (Initials)

Reviewed by: ______________

## WELL PURGING

### PURGE VOLUME

Casing Diameter (D in Inches): ________

Total Depth of Casing (TD in ft BTOC): ________

Water Level Depth (WL in ft BTOC): ________

No. of Well Volumes to be purged (# V): ________

### PURGE METHOD

☐ Bailer - Type: ______________________

☐ Submersible - Type: ______________________

☐ Other - Type: ______________________

### PUMP INTAKE SETTING

☐ Near Bottom ☐ Near Top

☐ Other ______________________

Depth in feet (BTOC): ______________________

Screen Interval in feet (BTOC): from ______ to ______

### PURGE VOLUME CALCULATION

( ________ - ________ ) X ____ $^2$ X 3 X 0.0408 = ________ gals

TD (feet) WL (Feet) D (inches) # V Calculated Purge Volume

### Field Parameter Measurement

| Minutes | pH | Conductivity (µS) | Temp. ☑ °C ☐ °F | Turbidity (NTU) |
|---|---|---|---|---|
| Initial | | | | |
| | | | | |
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| | | | | |
| | | | | |
| Meter S/N | | | | |

### PURGE TIME

Purge Start: ______________

Purge Stop: ______________

Elapsed: ______________

### PURGE RATE

GPM: ____________

GPM: ____________

### PURGE VOLUME

Volume: ______________ gallons

Observations During Purging (Well Condition, Color, Odor):

______________________________________

______________________________________

Discharge Water Disposal: ☐ Sanitary Sewer

☐ Storm Sewer ☐ Other

## WELL SAMPLING

☐ Bailer - Type: ______________________

Sample Time: ______________________

| Sample No. | Volume/Cont. | Analysis Requested | Preservatives | Lab | Comments |
|---|---|---|---|---|---|
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## QUALITY CONTROL SAMPLES

| Duplicate Samples | | Blank Samples | | Other Samples | |
|---|---|---|---|---|---|
| Original Sample No. | Dupl. Sample No. | Type | Sample No. | Type | Sample No. |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

**Photographic Reporting Data Sheets**

**Job #** ______________________________

**Photographer Name:** ______________________________

| Picure ID | Time Taken | Location | Picture Description (including subject, picture orientation [which direction you were facing when taking the picture], distance to subject, and scale of subject) |
|---|---|---|---|
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# Field Well Completion Form

Well Name:

Job Name:

Job Number: Date:

Project Manager:

Logged by:

Drilling Company:

Driller:

**Equipment:**

_________ Inch Hollow Stem Auger
_________ Inch Air Rotary
_________ Inch Mud Rotary
_________ Inch Sonic Drill Rig
_________ Other:____________

Type of drilling Fluids:
Water: ______
Mud: ______
Polymers: ______

Gallons of water Used During Drilling:________

Method of Decontamination
Prior to Drilling

Water discharged to:
_____Ground Surface _____Tank Truck
_____Storm Sewers _____Storage Tank
_____Drums _____Other:________

**Materials Used**

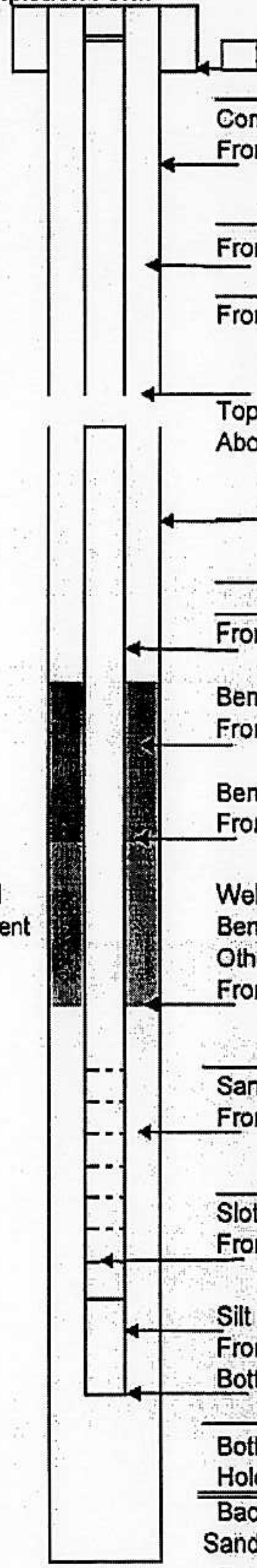
_______Sacks of ______________________Sand
_______Sacks of ______________________Cement
_______Gallons of Bentonite Cement Grout Used
_______% Powdered Bentonite
_______Gallons of Bentonite Slurry Used
_______Sacks of Bentonite Gel
_______Pounds of Bentonite Chips/Pellets*
_______Feet of _____ Inch PVC/S.S.* Blank Casing
_______Feet of _____ Inch PVC/S.S.* Slotted Casing
Slot Size _____
_______Feet of _____ Inch Steel Conductor Casing
_______Cu. Yd. Cement-Sand Backfill

**Backfill Material**

_______Sacks of ______________________Sand
_______Pounds of Bentonite Chips/Pellets*
_______Other______________

Concrete Pumper Used_____Yes _____No
Well Cover Used: _____ Locking Steel Cover
_____Christy Box
_____other___________

Silt Trap Used _____ Yes _____ No



Locking Steel Cover:
____ Inch Diameter Steel
Conductor Casing
From______ To________

____Bentonite- Cement Seal
From______ To________

____Bentonite Slurry Seal
From______ To______Feet

Top of Casing at _____ Feet
Above/Below Ground Surface

_____ Inch Diameter Borehole

_____ Inch Diameter Schedule
_____ PVC Blank Casing
From______ To______Feet

Bentonite Cement Seal
From______ To______Feet

Bentonite Slurry Seal
From______ To______Feet

Well Seal Type:
Bentonite Chips:_____
Other: _____
From______ To______Feet

Sand Pack
From______ To______Feet

_____Inch Diameter
Slotted (______Inch) Screen
From______ To______Feet

Silt trap_____Yes_____No
From______ To______Feet

Bottom of Well Cap
_____Feet

Bottom of Borehole:_____
Hole Cleaned Out To:_____Feet

Backfilled with Bentonite Chips/
Sand/Slurry/Other*:__________
From______ To______Feet

Not To Scale

Additional Information: Video logged /E-Logged*_____Yes_____No

* Circle applicable

**Reviewed by:**_____________

**MACTEC Engineering and Consulting Inc.**

# Well Development Form

Project: ____________________ Development Method ____________________ Well No. ____________________

Personel: ____________________ ____________________ Date: ____________________

| Time | Depth to water ft. | Gallons Removed | Turbidity (Ntu) | ph | Electrical Conductivity | D.O. mg/liter | Redox Mv | Recovery Rate Inches/min. | Recovery Rate gpm | |
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Total Gallons Removed: ____________________

MACTEC

# Water Level Measurement Log

Job Number:______________
Date:______________
To:______________
Initials:______________
Reviewed by:______________

| Well Name | Date | Time | First Reading | Second Reading | Initials | Comments |
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MACTEC

APPENDIX H

INDOOR CAP INSPECTION AND AIR/SOIL VAPOR SAMPLING, BUILDING 228 REMEDIAL UNIT [EKI]

REVIEWED BY: RR

**APPENDIX H**
**INDOOR CAP INSPECTION AND AIR/SOIL VAPOR SAMPLING**
**BUILDING 228 REMEDIAL UNIT**

An Appendix to the
*Final Corrective Action Implementation Work Plan, Building 207/231 Area*
*Presidio of San Francisco, California*
*October 23, 2008*

*Prepared for:*

Presidio Trust
San Francisco, California
(EKI A70004.20)

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June 2008

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signed 10/22/08

10/22/08

Date

**DRAFT BUILDING 228 INDOOR AIR AND CAP ASSESSMENT WORK PLAN**

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# 1.0 INTRODUCTION

On behalf of the Presidio Trust ("Trust"), Erler & Kalinowski, Inc. ("EKI") has prepared this Building 228 Indoor Air and Cap Assessment Work Plan as an appendix to the *Draft Corrective Action Implementation Work Plan, Building 207/231 Area, Presidio of California*, ("Implementation Work Plan") dated 15 February 2007 prepared by MACTEC (MACTEC, 2007). Building 228 ("Site") is located in the northeast corner of the Presidio, in the Letterman Complex Planning District within Area B of the Presidio, between Halleck Street and Building 229 (see Figure 1). Building 228 is within an area being addressed by the Trust in the Building 207/231 Corrective Action Plan ("CAP") (MACTEC, 2006). The approved corrective action in the CAP for the petroleum-hydrocarbon impacted soil near Building 228 (Existing Building 228 Area co-located Soil and Groundwater Remedial Units) is capping and adoption of a land use control. As described in the CAP, the building foundation of Building 228 and the paved area outside of Building 228 will serve as a cap to limit potential exposure to residual petroleum hydrocarbons and volatile organic compounds under and near Building 228.

This Work Plan includes an assessment of the potential for vapor intrusion into indoor air within Building 228, assessment of the indoor portion of the cap as needed based on analytical results of soil gas sampling, and review of needs for potential improvements to the indoor portion of the cap if necessary. The cap inspection activities for the area outside Building 228 are identified in the Implementation Work Plan, and thus are not included in this appendix to the Work Plan. To assess potential chemicals which may be present in indoor air due to vapor intrusion from the subsurface, soil gas samples are proposed to be collected and analyzed from five locations outside the building perimeter. Soil gas samples from outside the perimeter are proposed because access to the subslab vapor is restricted by the concrete thickness and equipment within the building. Additionally, Building 228 is located on a slope, leaving a wedge between the original grade and the building slab as the grade falls. The composition (and potential presence of) the fill is not certain and an opening to the wedge (potentially a former pipe chase) was noted on the northern side of the building. Samples collected from beneath the slab of Building 228 would not be representative of compounds potentially present below the building due to the presence of ambient air in the wedge. Therefore, data gathered from subslab sample collection would be questionable. The results of soil gas sampling will be compared to applicable published screening criteria (or site-specific values) for COCs in soil gas and potential risks due to vapor intrusion into indoor air will be evaluated.

EKI has prepared this Work Plan to implement the vapor intrusion and possible cap assessment at Building 228 in accordance with the Building 207/231 CAP and CAP Implementation Work Plan.[1] The approach of this Building 228 Work Plan was

[1] The CAP calls for indoor air monitoring. However, at the Building 1040 site, a similar CAP site where the CAP identified indoor air monitoring, the Water Board has indicated that, given the Site conditions, it would be more appropriate to assess potential vapor intrusion risks at the Site using soil gas data. Indoor air monitoring is not a component of this assessment, but it could be a follow-up activity if soil gas data indicate potentially significant risks to future building occupants. In consultation with the Water Board and

developed taking into account the California Environmental Protection Agency, Department of Toxic Substances Control ("DTSC") guidance entitled *Interim Final Guidance for the Evaluation and Mitigation of Subsurface Vapor Intrusion to Indoor Air,* (DTSC, 2004), U.S. Environmental Protection Agency ("U.S. EPA") guidance entitled *OSWER Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils (Subsurface Vapor Intrusion Guidance)* (US EPA, 2002), and consultation with the Trust, the National Park Service ("NPS"), Regional Water Quality Control Board, San Francisco Bay Region ("Water Board"), and DTSC. The Work Plan incorporates site visits to Building 228 with Trust representatives where potential sample locations were selected and marked. This Work Plan will be provided to the NPS, Water Board, DTSC, and members of the Restoration Advisory Board ("RAB"). Collectively, these parties are referred to as the "stakeholders." The scope of work will be conducted in accordance with the Presidio-wide Quality Assurance Project Plan ("QAPP") (Tetra Tech, 2001).

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other stakeholders, the Trust is initially planning to assess potential vapor intrusion risks through soil gas sampling in order to address the CAP requirement for indoor air sampling.

## 2.0 BACKGROUND

Detailed site background and remedial approach for the Building 207/231 Area is provided in the Building 207/231 CAP (MACTEC, 2006) and the Implementation Work Plan (MACTEC, 2007). According to the Building 207/231 CAP, Building 228 was constructed in 1909 and formerly operated as a bakery, a warehouse, and later as a laundry facility. Records show that wastewater presumably associated with dry cleaning operations was treated in the building. Three former 750-gallon underground storage tanks ("USTs") (Tanks 228.1, 228.2, and 228.3) were located to the north of Building 228 and were used to store Stoddard solvent used for dry cleaning. A fuel distribution system ("FDS") pipeline ran along the southern side of the building and connected to the building on the southeast side. The Army removed the tanks and pipeline in 1993. The building itself is considered a historic structure with contributive value to the National Historic Landmark and is therefore planned to be preserved. Building 228 is currently utilized as a carpentry shop.

The Building 207/231 CAP identifies two limited areas of residual impact: (1) petroleum hydrocarbon and volatile organic compound ("VOC") impacted soil and groundwater between the Site and the historic wall to the north of the building and around the former USTs occupying approximately 330 square feet, identified as the Northern Soil RU, and (2) petroleum hydrocarbon impacted soil around the former fuel distribution pipeline on the south side of the building occupying approximately 80 square feet, identified as the Southern Soil RU. Maximum concentrations of contaminants are identified in Tables 1 through 5 in MACTEC's *Data Gaps Investigation Report, Building 207/231 Area, Presidio of San Francisco, California*, dated 16 December 2004 (MACTEC, 2004).

Data from the Building 207/231 CAP (MACTEC, 2006) indicate that in the Northern Soil RU, residual concentrations of total petroleum hydrocarbons ("TPH") as gasoline and diesel, ethylbenzene, and xylenes exceed applicable cleanup levels in soil, and TPH gasoline, TPH diesel, and 1,2-dichlorobenzene ("1,2-DCB") were also detected in groundwater above applicable cleanup levels. In the Northern Soil RU, the maximum detected concentration chemicals in soil and groundwater that exceed applicable cleanup levels are summarized below:

| Maximum Concentrations of Chemicals Detected in Soil | | |
|---|---|---|
| Compound | Detected Concentration (mg/kg) | Applicable Cleanup Level (mg/kg) |
| TPH diesel | 150 | 115 |
| TPH gasoline | 4,100 | 11.6 |
| Ethylbenzene | 49 | 5 |
| Xylenes | 90 | 5.7 |

| Maximum Concentrations of Chemicals Detected in Groundwater | | |
|---|---|---|
| Compound | Detected Concentration (µg/L) | Applicable Cleanup Level (µg/L) |
| TPH fuel oil | 2,400 | 443 |
| TPH diesel | 5,900 | 443 |
| TPH gasoline | 970 | 443 |
| TPH unknown gasoline | 8,700 | 443 |
| 1,2-dichlorobenzene | 17 | 14 |

In the Southern Soil RU, TPH diesel and fuel oil were detected in soil at concentrations of 2,500 and 2,400 mg/kg, respectively, above their respective cleanup levels of 115 and 144 mg/kg.

Limited access and the planned land use make capping an appropriate remedial alternative.[2] The approved remedial action for the Building 228 Area is to maintain and monitor the existing cap, impose a land use control, and implement groundwater monitoring.

The dry cleaning equipment within Building 228 remains in place, though dry cleaning operations ceased in the building in 1984 or 1985. The location of the building on a slope and gaps between the ground and building foundation limit the ability to collect reliable subslab vapor samples from within the building footprint. EKI's review of available building drawings and a site walk confirm the difficulty in collecting representative subslab samples. Therefore, EKI proposes perimeter soil gas sampling to identify potential chemicals in the subsurface at Building 228 that could volatize into indoor air. The scope of this investigation includes collecting soil gas samples, and possible inspection of the building slab for functionality as a cap and identification of potential improvements for cap integrity.

The objectives and rationale of the soil gas sampling and testing program are described in the Data Quality Objectives section, below.

[2] The Water Board has expressed concern about naphthalene's potential for vapor intrusion. Naphthalene was not detected in one soil sample from the Southern Soil RU.

# 3.0 DATA QUALITY OBJECTIVES

The data quality objectives ("DQOs") are designed to guide the collection of additional data needed to evaluate the potential for human health risks in indoor air from residual COCs in soil under Building 228. Although DQOs are not generally prepared for Water Board-lead investigations, DQOs have been prepared for this project to illustrate the decision making process. The DQOs are presented in Table 1. Though the Trust's future plans for Building 228 are uncertain, the risk to future recreational or commercial building occupants from exposure to residual subsurface chemicals through the vapor intrusion exposure pathway should be evaluated to provide criteria for likely utilization of the facility.

As described in Table 1 and shown on Figure 1, a total of five soil gas sample locations are proposed at Building 228, in locations on the accessible sides of the building. The results of the soil gas sampling event will be used to evaluate potential risk via the vapor intrusion pathway. All samples will be analyzed for VOCs; only samples 228SG103 and 228SG104 will be analyzed for polycyclic aromatic hydrocarbons ("PAHs"). These two samples are near the Southern RU where the FDS Line was located. The DTSC guidance states that if calculated hypothetical health risks for potential future populations at a given sampling location are equal to or less than a cumulative lifetime incremental cancer risk of one-in-one million ($10^{-6}$) or a total non-carcinogenic hazard index ("HI") is equal to or less than one, indoor air sampling need not be performed. As the building is occupied in a limited use fashion and will undergo major renovation prior to full-time commercial use, indoor air sampling is not appropriate. If the risks associated with concentrations in soil gas exceed the ESLs, then the Trust will evaluate potential options for follow-up and assessment prior to development and building occupancy. These options could include the following, and others: (1) performance of indoor air sampling after the building has been cleaned up, (2) assessment of applicable site-specific goals based on the actual planned land use, or (3) incorporation of mitigation measures into the planned redevelopment.

# 4.0 FIELD ACTIVITIES

## 4.1 Pre-Field Activities

The Trust, NPS, and EKI will select soil gas sampling locations in the field; the Water Board, DTSC, and RAB will be invited to the field meeting to provide field input if they choose. EKI will contact Underground Service Alert prior to the initiation of subsurface work, and the utility owners and Trust Utility Department will provide utility clearance prior to drilling. EKI will prepare a site-specific health and safety plan for its workers, and prepare subcontracts with the California-licensed drilling contractor.

## 4.2 General Field Procedures

### *4.2.1 General Field Procedures for Collection of Soil Gas Samples*

As described in the DQO table (Table 1), EKI will collect soil gas samples from up to 5 locations outside Building 228, as indicated on Figure 2. Using direct push technology, EKI's soil gas sampling contractor will install temporary soil gas implants in accordance with the joint DTSC and the California Regional Water Quality Control Board – Los Angeles Region ("LARWQCB") *Advisory – Active Soil Gas Investigations*, dated 28 January 2003 (DTSC and LARWQCB, 2003) ("State Advisory"), the procedures outlined in Appendix A, and Standard Operating Procedures ("SOP") SOP 011, SOP 014, and SOP 015 of the Trust QAPP (included as part of Appendix A). Soil gas samples will be collected from as close as reasonably practical to the buildings (approximately 2-4 feet from the walls) and approximately 5 feet below ground surface ("bgs"), at least 1 foot above local groundwater elevation measured in the nearby groundwater monitoring wells. The soil gas samples will be collected in laboratory-supplied SUMMA canisters (for VOCs) and sorbent cartridges (for naphthalene). The vacuum in each SUMMA canister will be recorded prior to collection of soil gas samples. The analytical laboratory will provide a flow regulation system for sample collection flow for each SUMMA canister. At each location, soil gas sample collection will be stopped when the vacuum in the SUMMA canister is approximately 5 inches mercury. Following completion of the collection of the sample in the SUMMA canister, a sorbent cartridge will be attached to the temporary tubing. An air pump with a flow regulator will be used to draw soil gas through the sorbent cartridge until a laboratory-specified amount of soil gas has been drawn through the sorbent cartridge. Temporary tubing to the implants will be removed after the soil gas samples have been collected. The soil gas investigation is anticipated to be completed in one day.

In accordance with the QAPP, sample location identification codes are based on "228" for Building 228; "SG" for soil gas; and sequential numbering starting at 101. The media sampled will be marked on the chain of custody form and input into the media field in the Trust database when the data are uploaded. In keeping with the QAPP, a soil gas sample from 5 feet below ground surface will be designated as 228SG101[5].

The proposed sample identification numbers, depths, and corresponding laboratory analyses are summarized in Table 2. As noted in Table 2, the actual sample number and depth may change based on field conditions encountered.

#### *4.2.2 General Field Procedures for Indoor Cap Assessment*

If the analytical results of soil gas sampling indicate a significant risk to human health (see Section 6.0), the indoor cap (floor of Building 228) will be inspected for visible cracks, penetrations, and gaps that could allow COCs to enter the building. Ideally the floor would be cleared and cleaned to facilitate the cap assessment. However, such clearing and cleaning may not be possible. While assessment of the indoor cap can be performed, the assessment is anticipated to be limited in scope to what can visually be seen. Therefore, EKI will visually inspect and photograph the floor, and will prepare a written description of the visible portions of the floor. Areas that cannot be seen will be noted. If penetrations, cracks, or other potential pathways that may allow the migration of COCs into the building are observed, physical improvements may be recommended to address the identified issues, likely during building renovations. However, depending on the data collected, there may be no indication of vapor intrusion and thus crack repair may not be needed. If large or blatant cracks or penetrations are observed, some options for sealing these penetrations could include concrete patches, epoxy sealants, or other means, depending on the conditions encountered. The suggested repairs, if any, may be performed by the Trust's Remediation Contractor, a separate contractor, or Trust maintenance personnel, depending on the tasks required, skill sets of the contractors, and purchasing process of the Trust. Modifications to the indoor cap, if any, will be documented in the Construction Completion Report. If no significant risk to human health is indicated by the analytical results of soil gas sampling, no indoor cap assessment will be performed.

### 4.3 Field Quality Control Samples

A field duplicate for the soil gas samples will be collected as part of this investigation. A field duplicate is a sample collected at the same time, and from the same source and depth as the associated primary sample. Field duplicate pairs are collected to assess the consistency or precision of the laboratory's analytical system. The QAPP specifies a frequency of ten percent for field duplicates; therefore, one field duplicate sample will be collected and submitted to the laboratory for analysis.

### 4.4 Post-Sample Collection Activities

After completion of the soil gas sampling, a State of California-licensed land surveyor will survey the sampling locations. EKI has assumed that PLS Surveys, Inc. of Alameda, California will perform the surveying under the direction of EKI. The surveyor will

report the survey coordinates in both NAD 27 and PLLW survey datums, as well as identify the control points used to prepare the survey.

Decontamination rinse water from the investigation, if any, will be drummed and sampled for characterization and appropriate disposal. Other anticipated investigation-derived waste includes containers of plastic bags with used personal protective equipment and non-hazardous trash. The non-hazardous trash will be disposed of with Trust municipal trash. Disposal of all wastes will be the responsibility of the Trust.

# 5.0 ANALYTICAL METHODS

The Trust plans to use Air Toxics, Ltd. of Folsom, California, a State-certified analytical laboratory to analyze the soil gas samples and duplicate sample. The soil gas samples and duplicate sample will be analyzed for VOCs by EPA Method TO-15, with SIM (if necessary to achieve detection limits to compare to ESLs) and for PAHs by EPA Method TO-13 on a standard two-week turnaround time. Per the Presidio QAPP, the laboratory will provide data in Level III package with 10 percent of the data being reported in a Level IV package.

The analytical quality control criteria are provided in the QAPP. Analytical data for soil gas samples will be validated by DataVal, Inc. of Novato, California.

# 6.0 EVALUATION OF POTENTIAL HUMAN HEALTH RISKS

The results of the soil gas sampling events will be compared to ESLs or site-specific goals for commercial/industrial workers.[3]

If ESLs are exceeded, site-specific goals for COCs identified in soil gas may be calculated using the Johnson and Ettinger ("J&E") model for soil gas (SG-ADV.xls) as published by U.S. EPA (2004). Presidio-specific parameters obtained during the Building 937 investigation (EKI, 2006) will be used to perform the calculations. The concentrations detected in soil gas will be compared to the calculated soil gas goals (risk-based target concentrations or RBTCs) as well as ESLs to support the overall assessment of the data obtained during implementation of the work plan.

The chemical-specific risks and HIs due to vapor intrusion measured in soil gas will be calculated for each population by summing the ratio of the maximum soil gas concentration with its respective $RBTC_{SG}$ for carcinogenic and non-carcinogenic COCs. For carcinogens, the summed ratio for each population will be multiplied by $10^{-6}$ to calculate estimated lifetime incremental cancer risks. For non-carcinogens, the summed ratio for each population will equal the total estimated Hazard Indices.

The equation for calculating the estimated lifetime incremental cancer risk for each population is as follows:

$$Risk_{population} = \sum \frac{C_{SG-i} \times 10^{-6}}{RBTC_{SG-c-i}}$$

where $C_{SG-i}$ is the maximum concentration of carcinogenic chemical "i" in the soil gas samples and $RBTC_{SG-c-i}$ is the risk-based soil gas carcinogenic target concentration for that chemical "i".

Similarly, the total Hazard Index ("HI") for each population is as follows:

$$HI_{population} = \sum \frac{C_{SG-i}}{RBTC_{SG-nc-i}}$$

[3] The future land use for Building 228 is uncertain at this time; the area is designated for commercial/recreational land use. Soil gas and indoor air calculations performed previously at the Building 937 Area (EKI, 2006) for recreational and commercial/industrial exposure scenarios resulted in more stringent risk levels for the commercial/industrial exposure scenario. The risk calculations were driven by the commercial/industrial exposure scenario. Therefore, only commercial/industrial exposure calculations are presented in this document.

where $C_{SG-i}$ is the maximum concentration of non-carcinogenic chemical "i" in the soil gas samples and $RBTC_{SG-nc-i}$ is the risk-based soil gas non-cancer target concentration for that chemical "i".

The results of the soil gas sampling event will be used to calculate potential risks, using the equations and methods described above. This information will be used to determine if further assessment of potential vapor intrusion risks is warranted.

## 7.0 FOLLOW-UP ACTIVITIES, REPORTING, AND SCHEDULE

EKI recognizes that the schedule of this sampling event is important to the Trust for coordination with the Building 207/231 CAP Implementation Work Plan. Field activities will commence upon stakeholder approval of this Work Plan. For planning purposes, EKI anticipates soil gas sampling will be performed in June or July 2008, assuming stakeholder approval is obtained by mid June 2008. It is anticipated that the soil gas sampling events can be completed in one day. Upon receipt of the laboratory data, EKI will review the data and calculate potential human health risks. EKI will provide the Trust with a summary of potential health risks within two weeks of the receipt of the laboratory data.

After review of the soil gas data, the Trust will schedule a conference call with the stakeholders to discuss the existing data. The discussion of the data may occur at a regularly scheduled Building 207/231 CAP Implementation data review session or, depending on the timing of data receipt and the Trust's needs to begin evaluating future options, a separate conference call may be held to discuss the data.

If chemical concentrations in the soil gas samples are less than the applicable ESLs or site-specific goals, then no further action with regard to vapor intrusion activities will be taken and an indoor cap assessment will not be performed. Upon receipt of validated analytical data and discussion with the stakeholders, the results of the sampling and the conclusions will be incorporated into a sampling report that can be included in the Building 207/231 CAP Implementation Construction Completion Report.

If chemical concentrations in the soil gas samples are greater than the applicable ESLs or site-specific goals, then the Trust will summarize the data and meet with the stakeholders (NPS, Water Board, RAB, and Trust Real Estate) to assess the options for follow-up assessment. The options will depend on the planned reuse of Building 228 and could include the following, among others:

- performance of indoor air sampling after the building has been cleaned up for a known future reuse;
- reassessment of applicable site-specific goals based on the final planned land use that will be determined by the Trust and their developer (e.g., a storage warehouse that is occupied only occasionally will have significantly less exposure than standard commercial/industrial use or recreational use); or
- incorporation of mitigation measures into the planned redevelopment (e.g., the reuse of the building could include the installation of positive pressure ventilation or subslab ventilation).

If the chemical concentrations in the soil gas samples are greater than the revised site-specific goals using the final planned land use exposure assumptions, the building's indoor air will be sampled for the constituents that were detected in the soil gas survey once the building has been cleaned up and prepared for reoccupation.

As stated above, the results of the sampling and the conclusions will be incorporated into a sampling report that can be included in the Building 207/231 CAP Implementation Construction Completion Report. However, the specific follow-up activities and the associated timing for implementation will depend on the planned reuse and the associated reuse schedule. Additional coordination work between Trust Real Estate and Remediation departments may be identified in the Completion Report. Notifications for reuse and construction at Building 228, if necessary, will be addressed in the land use control documentation.

## 8.0 REFERENCES

DTSC, 2004. *Interim Final Guidance for the Evaluation and Mitigation of Subsurface Vapor Intrusion to Indoor Air*. December. Revised Feb. 7, 2005.

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Regional Water Quality Control Board, San Francisco Bay Region, *Site Cleanup Requirements, Presidio of San Francisco, California*, Order R2-2003-0080.

Tetra Tech, 2001. *Presidio-Wide Quality Assurance Project Plan, Sampling and Analysis Plan, Presidio of San Francisco, California*. April.

US EPA, 2002. *OSWER Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils (Subsurface Vapor Intrusion Guidance).* November.

DRAFT

# TABLE 1
# BUILDING 228 DATA QUALITY OBJECTIVES
Presidio of San Francisco, California

| State the Problem | Identify the Decisions | Identify Inputs to the Decisions | Define the Study Boundaries | Develop Decision Rules | Specify Limits on Decision Errors | Optimize the Design |
|---|---|---|---|---|---|---|
| Total petroleum hydrocarbons ("TPH") as gasoline, diesel, and fuel oil and volatile organic compounds ("VOCs") have been detected in soil and groundwater above applicable cleanup levels in areas north of Building 228 and TPH as diesel and fuel oil have been detected in soil above applicable cleanup levels south of Building 228. An indoor air assessment will be conducted to evaluate the potential for vapor intrusion of VOCs from the subsurface into indoor air. Inspection of the building slab may also be performed to assess potential for vapor intrusion if the analytical results of soil gas sampling demonstrate that VOCs are present in concentrations that pose a potentially significant risk to human health.<br><br>Three former underground storage tanks (228.1, 228.2, and 228.3) are located to the north of the building were used by the Army to store Stoddard solvents for the dry cleaning operations at Building 228. The tanks have been removed; however, contaminated soil in this area cannot be removed without compromising the historical wall's structural integrity.<br><br>This sampling program is proposed to evaluate whether residual subsurface chemicals pose a significant risk to future recreational or commercial building occupants through the vapor intrusion exposure pathway.<br><br>Effectiveness of subslab vapor sampling is limited by the position of the building on a slope and subslab access; therefore, perimeter soil gas sampling is proposed. | 1. Are residual petroleum hydrocarbons and VOCs from previous Army impacts present in the soil gas at Building 228?<br><br>2. If residual petroleum hydrocarbons and VOCs are present in the subslab vapor or soil gas, are they present at concentrations that are potentially a significant risk (i.e., greater than $10^{-6}$ lifetime incremental cancer risk or a cumulative noncancer hazard index ("HI") >1)?<br><br>3. Does the existing slab and foundation of Building 228 provide a sufficient cap for limiting potential exposure to residual petroleum hydrocarbons in the subsurface? Are improvements or modifications necessary to enhance the cap? | 1. Results of previous chemical analysis of soil and groundwater samples.<br><br>2. Results of chemical analysis from soil gas investigation.<br><br>3. DTSC Guidance.<br><br>4. Visual assessment of the building slab. | The study boundaries for the soil gas investigation are near the perimeter of Building 228 (south of the historic wall) as internal subslab access is not available.<br><br>The indoor cap assessment, if performed, will be conducted within Building 228. | 1. If chemical concentrations are detected in soil gas samples, potential risks associated with those chemicals due to vapor intrusion will be assessed. If potential risks are not significant, then no further vapor intrusion assessment is warranted. If no chemicals are detected in the soil gas samples, then no further action will be warranted and no indoor cap assessment will be performed.<br><br>2. If the risk associated with chemicals in soil gas due to vapor intrusion is less than or equal $10^{-6}$ for carcinogens or a HI of 1 for non-carcinogens, then no indoor cap modifications will be proposed and no indoor cap assessment will be performed.<br><br>3. If chemical concentrations in soil gas pose a risk greater than $10^{-6}$ for carcinogens or greater than an HI of 1, the Trust can present potential options in the completion report for follow-up assessment during development activities. An indoor cap assessment will be performed.<br>. | 1. Field, analytical, and data validation procedures will follow the QAPP (Tetra Tech, 2001), as modified to follow DTSC Guidance. Duplicate soil gas samples will also be collected per the QAPP. | The portion of Building 228 acting as a cap is approximately 75' x 70'.<br><br>1. Five soil gas samples and one duplicate sample will be collected from locations outside Building 228, as shown on Figure 2. Subslab vapor samples cannot be collected due to access constraints and crawl space below the building. Samples will be collected from the soil gas from areas near the known impacted soil and around the perimeter of the building. Probes will be advanced to collect soil gas samples at approximately five feet below ground surface. Soil gas samples will be collected in SUMMA canisters and analyzed by a fixed laboratory for VOCs using US EPA Method TO-15 with SIM, if necessary. The two samples near the southeastern corner of the building will be collected on sorbent cartridges and analyzed for PAHs using US EPA Method TO-13. Duplicates of 10% of the soil gas samples will also be analyzed by US EPA Methods TO-13 and TO-15. Soil gas data will be validated by a data validation firm. |

Abbreviations:

| | |
|---|---|
| DTSC | Department of Toxic Substances Control, California Environmental Protection Agency |
| DTSC Guidance | *Interim Final, Guidance for the Evaluation and Mitigation of Subsurface Vapor Intrusion to Indoor Air*, DTSC, dated 7 February 2005. |
| HI | Hazard Index |
| PAHs | polycyclic aromatic hydrocarbons |
| QAPP | *Presidio-Wide Quality Assurance Project Plan, Sampling and Analysis Plan*, Tetra Tech EM Inc., dated April 2001. |
| TPH | total petroleum hydrocarbons |
| US EPA | U.S. Environmental Protection Agency |
| VOCs | volatile organic compounds |

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# TABLE 2
# SAMPLE LABORATORY ANALYSIS MATRIX

Presidio of San Francisco, California

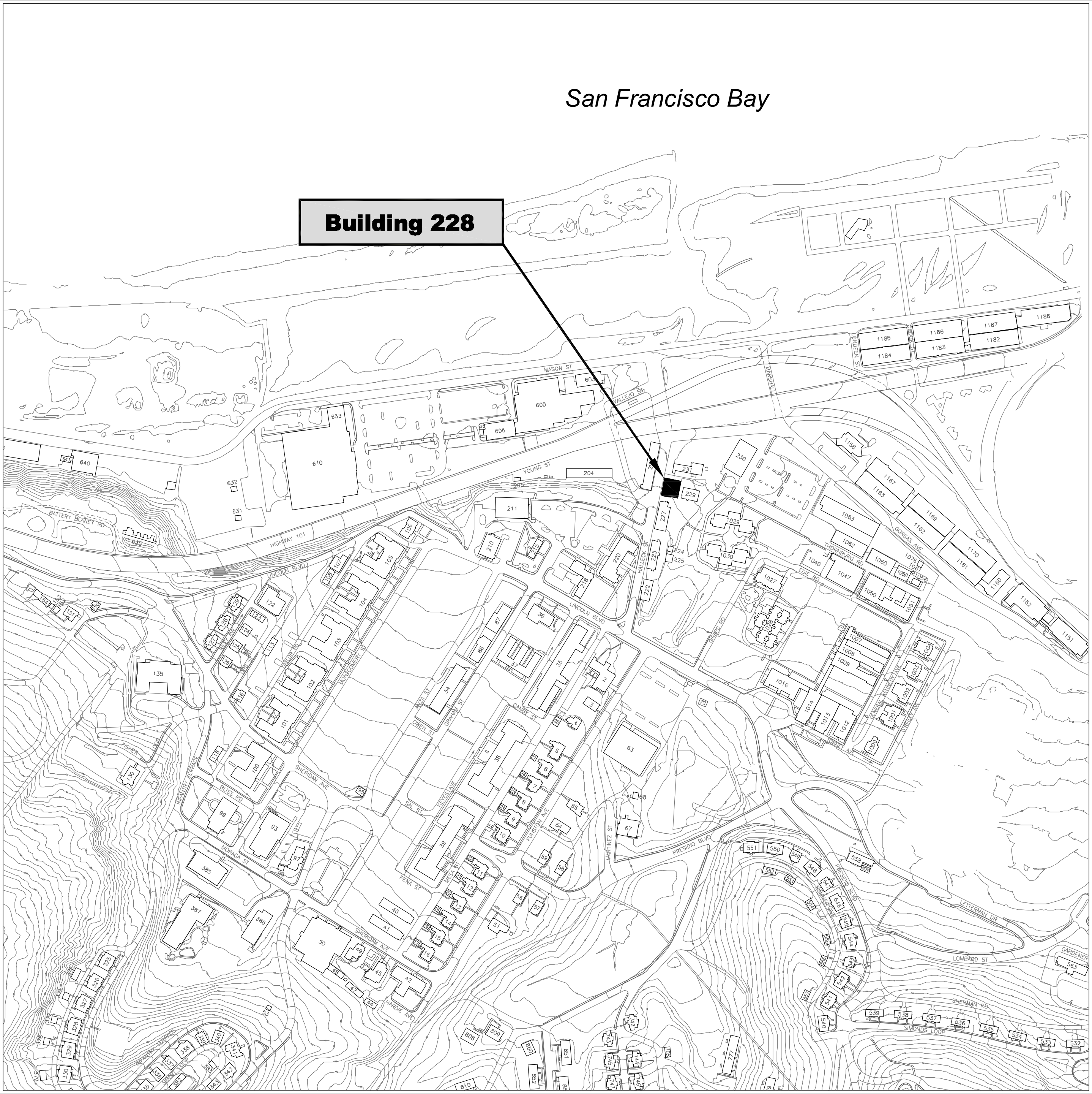
| Sample ID | Sample Depth (ft bgs) (note 1) | Matrix | Laboratory Analyses | |
|---|---|---|---|---|
| | | | VOCs (US EPA TO-15) | PAHs (US EPA TO-13) |
| *Soil Gas Samples* | | | | |
| 228SG101(5) | 5 | soil gas | * | |
| 228SG102(5) | 5 | soil gas | * | |
| 228SG103(5) | 5 | soil gas | * | * |
| 228SG104(5) | 5 | soil gas | * | * |
| 228SG105(5) | 5 | soil gas | * | |

Abbreviations:

ft bgs – feet below ground surface
ID – identification
QA/QC – quality assurance/ quality control
PAHs – polycyclic aromatic hydrocarbons
VOCs – volatile organic compounds
US EPA – United States Environmental Protection Agency

Notes:

(1) Proposed soil sample depths may be modified based on field conditions.
(2) Per QAPP guidance, one duplicate will be collected for every ten samples on each day of the field work. A duplicate sample will be noted with "DUP" in the Sample ID. Duplicate may be collected from 228SG103.




Reference: Basemap source: Presidio Trust, 2006.

Note:

1. All locations are approximate.

N

0 600 1200

(Approximate Scale in Feet)

**DRAFT**

**Erler & Kalinowski, Inc.**

Site Location Map

Building 228
The Presidio Trust
San Francisco, CA
May 2008
EKI A70004.20

Figure 1

20080522.10450742 G:\A70004.20\May07\Bldg 228\Figure 01 – Site Location Map.dwg Layout1


Reference: Basemap source: Presidio Trust, 2006.

**DRAFT**

Legend:

- Proposed Soil Gas Sampling Location

Note:

1. All locations are approximate.

0 20 40

(Approximate Scale in Feet)

**Erler & Kalinowski, Inc.**

Proposed Sampling Locations

Building 228
The Presidio Trust
San Francisco, CA
May 2008
EKI A70004.20

Figure 2

20080522.10460433 G:\A70004.20\May07\Bldg 228\Figure 02 - Proposed Sampling Locations.dwg Layout1

# Appendix A

## Field Methods and Procedures For Soil Gas Sampling

And

## Selected Standard Operating Procedures

**from**

***Presidio-Wide Quality Assurance Project Plan, Sampling and Analysis Plan.* April 2001**

# APPENDIX A

## FIELD METHODS AND PROCEDURES FOR SOIL GAS SAMPLING

Building 228, Presidio of San Francisco, California

### A-1 Soil Gas Sampling

Soil gas sampling will be conducted generally in accordance with Trust Standard Operating Procedure No. 011, Soil Gas Sampling Methods, found in the Trust QAPP, and the joint Department of Toxic Substances Control ("DTSC") and Regional Water Quality Control Board, Los Angeles Region ("LARWQCB") guidance, entitled *Advisory—Active Soil Gas Investigations* and dated 28 January 2003. Samples will be collected in a 6-liter SUMMA canister and on a sorbent cartridge provided by the analytical laboratory.

To collect soil gas samples, a boring will be advanced by direct push technology to the desired sampling depth, 5 feet below ground surface ("bgs"). Once the desired depth is achieved, a stainless steel implant connected to polyethylene tubing (1/4-or-1/8 inch diameter) will be placed in the bottom of the hole and covered with 6-12 inches of sand. Above the sand, the hole will be filled with hydrated bentonite to create a seal. The sample tubing will protrude through the bentonite to allow collection of the soil gas sample from the implant. Subsurface conditions will be allowed to equilibrate for 30 minutes before purging and sampling in accordance with current state guidelines. Because a fixed laboratory will be used, a purge volume test will not conducted prior to collection of soil gas samples. As part of the Building 937 soil gas investigation in July 2006, TEG of Rancho Cordova, California collected soil gas samples and analyzed the samples using EPA Method 8260 in a mobile laboratory. TEG performed a purge volume test by analyzing samples collected after 1, 3, and 7 purge volumes were removed from the soil gas implant. TEG found that 7 purge volumes produced the highest concentrations of VOCs. For this investigation, 7 purge volumes will be purged into a "purge" SUMMA canister at each location prior to the collection of the soil gas sample that will be analyzed by the analytical laboratory.

The volume of gas to be purged will be calculated for each sample location based on the following variables:

- Length of filter pack in inches ("FP");
- Borehole diameter in inches ("BH");
- Length of tubing used in feet ("TL");
- Inner diameter of tubing in inches ("TD")
- Flow rate of SUMMA canister in milliliters per minute ("FR").

The formula to determine one purge volume is:

$$PV = CF*[FP*\pi*(0.5*BH)^2 + 12*TL*(0.5*TD)^2]$$

Where PV is one purge volume (in liters), and CF is a unitless conversion factor of 0.016387 to convert cubic inches into liters.

Since seven purge volumes will be purged prior to sample collection, the formula to determine the purge time is:

Time (minutes) = 7*PV / (1000*FR)

The joint LARWQCB and DTSC guidance recommends a purging and sampling rate for filling of SUMMA canisters of between 100 and 200 milliliters/minute. The analytical laboratory will set all flow regulators to be used for soil gas purging and collection of soil gas samples to fill at the same rate and at a value in the range recommended. The analytical laboratory will communicate the rate to EKI when the SUMMA canisters are shipped.

The purge SUMMA canister and sample collection SUMMA canister will be connected such that no tubing or piping will be removed or reconnected between the purging and sample collection. After the appropriate volume of gas has been purged, the valve to the purge SUMMA canister will be closed and the valve to the sample collection SUMMA canister opened. The valve to the sample collection SUMMA canister will be closed when there is approximately 5 inches Mercury of vacuum pressure in the canister. The final vacuum pressure will be recorded. If a SUMMA canister arrives at Air Toxics with no remaining vacuum pressure, that SUMMA may not be analyzed due to the possibility that a vacuum leak occurred following completion of sampling at that location.

During sampling leak detection compounds, such as 1,1-difluoroethane or tetrafluoroethane, which are found in “dust-off” sprays, will be regularly discharged around all tubing joints where leakage of ambient air into the system could potentially occur. These compounds were selected as the leak detection compounds because they are non-toxic gases that are easily identifiable during analysis and do not occur at contaminated sites. Therefore, it does not interfere with the quantitative analysis of VOCs.

After sampling into the SUMMA has been completed, the purge and sample collection SUMMAs will be removed from the tubing. The sorbent cartridge used for collection of the soil gas sample to be analyzed by US EPA Method TO-13a will be attached to the tubing. An air pump with a flow regulator will be attached to the sorbent cartridge using clean tubing. Following connection of the sorbent cartridge to the tubing and the air pump, 20 liters of soil gas will be pulled from the boring through the sample cartridge at a rate between 100 and 200 mililiters/minute. Exposing the sorbent cartridge to 20 liters of soil gas will insure that the detection limit for naphthalene is lower than the applicable ESL for shallow soil gas. After 20 liters of soil gas has been pulled through the sorbent cartridge, the pump will be shut off and the sorbent cartridge packed according to laboratory instructions.

A field duplicate soil gas sample for analysis at a fixed laboratory will be collected from sample location 228SG101in the manner described above.

At the discretion of the Trust, sampling tubing may be left in place for possible resampling at a later date. When sampling has been completed, the tubing will be removed and the bentonite will seal the boring. Borings within concrete or asphalt will be repaved upon completion of the work.

## A-2.0 Disposal of Investigation-Derived Wastes

Wastes generated during the investigations at Building 228 will include gloves and other personal protective equipment. Since the soil gas samples will be collected by direct push technology, no soil residuals are anticipated. Any wastes generated during the sampling event will only be exposed to limited vapor concentrations which are not likely to contain chemicals of concern. Therefore, no hazardous waste residuals are expected from the sampling event.

## SOP APPROVAL FORM

## THE PRESIDIO TRUST
## ENVIRONMENTAL STANDARD OPERATING PROCEDURE

## SOIL GAS SAMPLING METHODS

## SOP NO. 011
## REVISION NO. 00

Last Reviewed: December 2000

Quality Assurance Approved

12 Jan 01
Date

## 1.0 BACKGROUND

Soil gas samples are collected in environmental investigations to assess the vapor phase of contaminants in the vadose zone (soil gas) or other gaseous constituents of interest. Soil gas samples can be collected using several methods. This standard operating procedure (SOP) presents sample collection procedures for collecting soil gas samples in Tedlar® bags, glass sampling bulbs, and stainless-steel canisters. Tedlar® bags and glass sampling bulbs are best suited for on-site or near-site chemical analysis, whereas steel canisters are best suited for shipping samples to a full service laboratory.

### 1.1 PURPOSE

The purpose of this SOP is to provide guidance for the use of Tedlar® bags, glass sampling bulbs, and stainless-steel canisters for soil gas sample collection. Soil gas samples collected by these methods may be analyzed for volatile organic compounds (such as trichloroethene, benzene, and toluene) and for inorganic parameters (such as nitrogen, oxygen, and carbon dioxide).

### 1.2 SCOPE

This SOP applies to all personnel collecting soil gas samples in Tedlar® bags, glass sampling bulbs, or stainless-steel canisters. The site-specific work and sampling plans should be followed during soil gas sampling activities.

### 1.3 DEFINITIONS

**Soil Gas:** The gases or atmosphere filling the void spaces in soils and unconsolidated sediments. These gases may all be of natural origin, but manmade contaminants or by-products may be present in detectable quantities.

**Tedlar® Bag:** Inflatable bag manufactured from proprietary non-reactive synthetic material impermeable to gases.

### 1.4 REFERENCES

American Society for Testing Materials (ASTM). 1993. "Standard Guide for Soil Gas Monitoring in the Vadose Zone." *Environmental Standards on Environmental Sampling*. Second Edition. 1997. ASTM D 5314–92. January.

U.S. Environmental Protection Agency (EPA). 1984. *Characterization of Hazardous Waste Sites – A Methods Manual: Volume II, Available Sampling Methods.* Second Edition. EPA-600/4-84-076. December.

EPA. 1988. *Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air.* Method TO-14. Atmospheric Research and Exposure Assessment Laboratory. Research Triangle Park, North Carolina. EPA-600/4-89/017. June.

EPA. 1990. "General Precautions in the Use of Canister Sampling for Measuring VOCs in Ambient Air." Office of Solid Waste and Emergency Response. Bulletin Board.

## 1.5 REQUIREMENTS AND RESOURCES

When using the Tedlar® bag collection method, the following items are needed:

- A sampling port and attached sampling line, ready for sampling
- A pump (SKC universal flow pump or equivalent), capable of pumping at least 3 liters per minute to allow purging of the sample point prior to collection of soil gas samples
- Sampling lines (dedicated, 0.375-inch outer diameter Tygon® tubing) to connect all field equipment
- "Y"-branched plastic (Teflon®-lined if available) sampling hose for duplicate collection
- 500-cubic-centimeter ($cm^3$) Tedlar® bags, with metal fittings
- Vacuum chamber

When using glass sampling bulbs to collect soil gas, the following items are needed:

- A supply of clean 250- or 500-milliliter (mL) glass gas sampling bulbs with stopcock valves
- Tygon® tubing or equivalent of appropriate size to connect the sampling bulb to the sample port and vacuum system
- A vacuum pump to purge the sampling system and to allow for sample collection. A vacuum/volume system capable of measuring purge volumes is desirable.
- A sampling system with an inline pressure gauge
- A source of heated air to purge and decontaminate the reusable glass sampling bulbs prior to initial use and between each subsequent use. This may consist of a simple hand-held hair drier.

When using steel canisters to collect soil gas, the following items are needed:

- A supply of clean, evacuated stainless-steel canisters (SUMMA® canisters) with a pressure gauge to verify internal pressure
- A vacuum pump (SKC universal flow pump or equivalent) to allow purging of the sample point prior to collection of soil gas samples
- Tygon® tubing or equivalent of appropriate size for connecting the sampling port to pump (during gas point purging) and the sampling port to stainless steel canister (during sample collection)
- Y-branched tubing (plastic, Teflon®-lined if available) for duplicate collection

## 2.0 PROCEDURES

This section describes selection of soil gas sampling locations and general preparation of the sampling system to be used. This section also provides detailed procedures for collecting samples using Tedlar® bags, glass bulbs, and stainless-steel canisters. Finally, this section discusses additional considerations that affect soil gas sampling (including duplicate and equipment blank sample collection, decontamination, and sample transfer) and summarizes the advantages and disadvantages of each sampling method.

### 2.1 SAMPLING LOCATION SELECTION

Sampling locations should be selected and prepared for sampling as described in a project-specific field sampling plan (FSP). Soil gas samples may be collected from depths as shallow as 3 feet or as great as 50 feet, depending on the objectives of the project, the site soil conditions, and the specific equipment used to penetrate to depth.

### 2.2 SAMPLING SYSTEM PREPARATION

Typical sample probe assemblies may consist of three types: (1) a hand-driven soil gas probe 4 feet in length, (2) a drill rig-driven soil gas probe 2 feet in length, and (3) a hydraulic-driven soil gas probe 3 feet in length. The probes may be assembled in series to reach the desired sampling depth. The probes will be driven to or emplaced at the desired sample collection depth, and then fitted with the Tygon® sampling line.

Once fitted with the sampling line, the ambient air within the sampling system is purged. Usually, three system volumes are purged prior to sample collection. If the sampling system purge volume cannot be measured, then a standard purge time of 3 to 5 minutes should be used.

After the system is purged of ambient air but before the pump is turned off, about 2 inches of the sampling line closest to the entrance port of the pump should be folded over itself and the tubing should be clamped to keep ambient air from reentering the system. This is not necessary when sampling with glass bulbs because the bulbs are already connected to the sampling line. After the system is purged and sealed to ambient air, the pump should be turned off. Sample collection can now proceed using a Tedlar® bag, a glass bulb, or a stainless-steel canister.

## 2.3 SAMPLE COLLECTION USING TEDLAR® BAGS

Soil gas can be collected for chemical analysis in a 500-$cm^3$ Tedlar® gas sampling bag. This can be accomplished by using an SKC pump to induce a vacuum on the exterior of the bag. This will cause the Tedlar® bag to be inflated with soil gas. The following procedure should be used:

1. Connect the free end of the Tygon® tubing (previously inserted through the top of the vacuum chamber) to the Tedlar® gas sampling bag. Open the valve on the gas sampling bag and place the tubing into the body of the vacuum chamber.

2. Place the top on the vacuum chamber.

3. Connect the free end of the evacuation tube to the SKC pump.

4. Turn on the pump. This should create a vacuum in the chamber, and the Tedlar® bag should fill at a rate of approximately 2 liters per minute. The rate at which the Tedlar® gas sampling bag fills will depend on the porosity and permeability of the soil.

5. The minimum amount of soil gas needed for analysis is approximately 0.25 liter.

6. If less than 0.25 liter is collected after 4 minutes of sampling, raise the soil gas probe 0.5 foot (if possible). Continue to evacuate the vacuum chamber for another minute. If the minimum required soil gas is not collected, repeat the procedure again. If the minimum required volume of soil gas is still not collected, abandon the collection process. All steps conducted are to be accurately recorded in the field logbook.

7. Remove the top of the vacuum chamber after the soil gas sample is collected in the Tedlar® bag.

8. Close the valve on the Tedlar® gas sampling bag, clamp the Tygon® tubing, and remove the Tedlar® gas sampling bag.

9. Turn off the pump.

10. Label the Tedlar® bag and its corresponding field datasheet (see Attachment A) with the sample number. An alternative documentation procedure is to enter the requisite information in the field logbook. Fill out the rest of the field datasheet.

## 2.4 SAMPLE COLLECTION USING GLASS BULBS

Soil gas also can be collected for chemical analysis in a glass bulb. When this sampling method is used, the glass bulb must be connected to the sampling system and purged of ambient air along with the sampling line before the sample is collected. The system is purged and the sample is collected using the following procedure:

1. Connect one end of the glass bulb to the sample line and the other end of the glass bulb to the vacuum pump using Tygon® tubing, and then open both stopcocks on the bulb.

2. Turn on the vacuum pump and purge the sampling system as discussed in Section 2.2.

3. Turn off the vacuum pump.

4. Observe the inline pressure gauge to determine when the vacuum in the bulb has been filled with soil gas. This may require several minutes, particularly in soils with low porosity and permeability. If the vacuum in the bulb has not dropped after 4 minutes of sampling, raise the soil gas probe in 0.5-foot increments in an attempt to find a more permeable zone. If the soil gas probe is moved, guard against leakage of ambient air into the system and repurge if necessary.

5. Once the vacuum in the gas sampling bulb has been filled, close off the upstream stopcock on the bulb, then the downstream stopcock and disconnect the bulb from the sample line.

6. Label the glass bulb and its corresponding field datasheet (see Attachment A) with the sample number. An alternative documentation procedure is to enter the requisite information in the field logbook. Fill out the rest of the field datasheet.

## 2.5 SAMPLE COLLECTION USING STAINLESS-STEEL CANISTERS

Soil gas also can be collected for chemical analysis in a stainless-steel, evacuated canister. Often, these canisters are used to collect duplicate samples for off-site analysis from locations that are being sampled for field screening analysis using Tedlar® bags or glass bulbs.

When this method is used, the canister is connected directly to the purged Tygon® sampling tube. To prevent ambient air from entering the canister during sample collection, all connections must be airtight. To collect soil gas samples using this method, the following procedure is used:

1. Measure the canister pressure reading, ambient air temperature, and ambient air pressure, and record the readings in the field logbook before sample collection.

2. Open the canister pressure valve, which will allow the evacuated stainless-steel canister to draw in soil gas until the canister reaches ambient pressure. When the sampling valve on the canister shows that ambient pressure has been reached, close the sampling valve and remove the canister from the sampling line.

3. Measure and record the post-sampling pressure reading on the canister pressure valve.

4. Label the canister and its corresponding field datasheet (see Attachment A) with the sample number. An alternative documentation procedure is to enter the requisite information in the field logbook. Fill out the rest of the field datasheet.

## 2.6 DUPLICATE AND EQUIPMENT BLANK COLLECTION

Duplicate soil gas samples will be collected at each site as required in the project-specific FSP. Generally, one duplicate sample will be collected for every ten samples collected. Each duplicate is collected in conjunction with a corresponding environmental sample.

To collect duplicate samples, a Y-branched sampling hose will be connected to the vacuum chamber or pump. Two Tedlar® bags, glass bulbs, or stainless-steel canisters will be attached, one to each end of the Y-branched hose. Sample collection will proceed as described above. After collection, one sample will be labeled as the environmental sample and one as the duplicate.

Equipment blanks also will be collected at each site as required in the project-specific FSP. Generally, one blank will be collected for every ten samples collected. Blanks will be collected by running ambient air through the sampling system immediately after it has been decontaminated, and by collecting the ambient air in a Tedlar® bag, glass bulb, or stainless-steel canister using the same procedures used to collect environmental samples. Blank sample collection is conducted upwind of any observed interference, and the location of the sampling should be recorded in the field logbook. Equipment blanks are collected to ensure that field equipment decontamination procedures are adequate.

## 2.7 DECONTAMINATION

Sampling probes should be decontaminated before the first sample is collected and between sampling points. Probes that are grossly contaminated should be decontaminated using a high-pressure steam cleaner. Probes that are not grossly contaminated can be decontaminated by brushing off loose soil particles, then heating the probes until they are warm to the touch to drive off any volatile contaminants. Heating times of 7 to 10 minutes are generally sufficient for this purpose. This brushing and heating method greatly reduces the generation of decontamination fluids.

Glass sampling bulbs also must be decontaminated between each use. This may be accomplished by purging heated air through the bulbs using a hand-held hair drier and the vacuum pump. Highly contaminated bulbs may require decontamination using either a methanol or soapy water wash and a deionized water rinse.

If Y-branched tubing or any other sampling equipment is to be reused, it must also be decontaminated between sampling locations.

## 2.8 SAMPLE TRANSFER

After collection, each sample container will be transported to the designated laboratory for analysis. In many cases, samples will be analyzed on site in a mobile laboratory.

## 2.9 ADVANTAGES AND DISADVANTAGES OF EACH SAMPLING METHOD

Tedlar® bags are relatively inexpensive to use but can only be used once and then must be disposed of. If the soil formation being sampled has a low porosity and permeability, such as clay or silty clay, it may not be possible to fully inflate the Tedlar® bag with soil gas.

Glass bulbs are more expensive than Tedlar® bags but they can be reused indefinitely, as long as they are not broken. However, bulbs must be decontaminated between each use, and periodic equipment blanks must be analyzed to verify that the decontamination procedures used are effective.

Stainless-steel canisters are very expensive and, therefore, are not cost-effective when conducting on-site analysis. The advantage of this type of sampler is that confirmation samples may be collected and shipped off-site for analysis with excellent assurance of sample integrity.

## 3.0 PRECAUTIONS

Both Tedlar® bags and glass bulbs are transparent to light, and many volatile compounds are subject to degradation in sunlight. As a result, samples should be stored in a dark place, such as a cooler, and analyzed as quickly as possible. In general, samples collected in Tedlar® bags or glass bulbs should be analyzed within 24 hours after collection, at a maximum. This will ensure sample integrity and minimize contaminant loss by degradation processes or absorption onto surfaces.

The concentration of volatile organic contaminants in the vapor phase in soil gas is a function of many complex and dynamic variables. Soil gas results do not usually show a direct correlation to groundwater contamination. However, soil gas may reflect to groundwater contaminant conditions and can be a useful tool for locating sources of volatile organic contamination in groundwater quickly and inexpensively.

While sampling, each sampling location should be screened with a flame ionization detector (FID) or photoionization detector (PID) following sample collection. The result of the FID or PID screening should be recorded on the sample container and field sheet so that the chemist analyzing the sample can determine whether sample dilutions or smaller sample volumes are required for analysis.

# ATTACHMENT A

# FIELD DATASHEET FOR SOIL GAS SAMPLING METHODS

## FIELD DATASHEET FOR SOIL GAS SAMPLING METHODS

Date: ______________________ Project/Site Name: ______________________

Time: ______________________ MWO No.: ______________________

Sample Container: ______ Tedlar® Bag: ______ Glass Bulb: _______ SUMMA® Canister: _______

Sampling Location and Depth: ______________________________________________

Description of Location: ______________________________________________

Sample Location Purged: Yes _____________ FID or PID (circle one) Reading: ______________

Sample Relinquished By: ______________________ Date/Time: ______________________

Sample Received By: ______________________ Date/Time: ______________________

Attach field copy of sample label or write in sample number.

Notes:

SOP APPROVAL FORM

THE PRESIDIO TRUST

ENVIRONMENTAL STANDARD OPERATING PROCEDURE

GENERAL EQUIPMENT DECONTAMINATION

SOP NO. 014

REVISION NO. 00

Last Reviewed: December 2000

Quality Assurance Approved

12 Jan 01

Date

## 1.0 BACKGROUND

All nondisposable field equipment must be decontaminated before and after each use at each sampling location to obtain representative samples and to reduce the possibility of cross-contamination.

### 1.1 PURPOSE

This standard operating procedure (SOP) establishes the requirements and procedures for decontaminating equipment in the field.

### 1.2 SCOPE

This SOP applies to decontaminating general nondisposable field equipment. To prevent contamination of samples, all sampling equipment must be thoroughly cleaned prior to each use.

### 1.3 DEFINITIONS

**Nonphosphate soap:** Alconox® and Liquinox® are common laboratory grade products

### 1.4 REFERENCES

U.S. Environmental Protection Agency (EPA). 1992. "RCRA Groundwater Monitoring: Draft Technical Guidance." Office of Solid Waste and Emergency Response. Washington, DC. EPA/530-R-93-001. November.

EPA. 1994. "Sampling Equipment Decontamination." Environmental Response Team SOP No. 2006. Revision No. 0.0. August 11. (On-Line Address: http://www.ert.org/media_resrcs/media_resrcs.asp.)

### 1.5 REQUIREMENTS AND RESOURCES

The equipment required to conduct decontamination is as follows:

- Scrub brushes
- Large wash tubs or buckets
- Squirt bottles
- Nonphosphate soap
- Tap water

- Distilled water
- Plastic sheeting
- Aluminum foil
- Methanol or hexane
- Dilute (0.1 N) nitric acid
- Steam cleaner

## 2.0 PROCEDURES

The procedures below discuss decontamination of personal protective equipment (PPE), drilling and monitoring well installation equipment, borehole soil sampling equipment, water-level measurement equipment, and general sampling equipment.

### 2.1 PERSONAL PROTECTIVE EQUIPMENT DECONTAMINATION

Personnel working in the field are required to follow specific procedures for decontamination prior to leaving the work area so that contamination is not spread off-site or to clean areas. All used disposable protective clothing, such as Tyvek® coveralls, gloves, and booties, will be containerized for later disposal. Decontamination water will be containerized in 55-gallon drums.

Personnel decontamination procedures will be as follows:

1. Wash neoprene boots (or neoprene boots with disposable booties) with Liquinox or Alconox solution and rinse with clean water. Remove booties and retain boots for subsequent reuse.
2. Wash outer gloves in Liquinox® or Alconox® solution and rinse in clean water. Remove outer gloves and place into plastic bag for disposal.
3. Remove Tyvek® or coveralls. Containerize Tyvek® for disposal and place coveralls in plastic bag for reuse.
4. Remove air purifying respirator (APR), if used, and place the spent filters into a plastic bag for disposal. Filters should be changed daily or sooner depending on use and application. Place respirator into a separate plastic bag after cleaning and disinfecting.
5. Remove disposable gloves and place them in plastic bag for disposal.
6. Thoroughly wash hands and face in clean water and soap.

## 2.2 DRILLING AND MONITORING WELL INSTALLATION EQUIPMENT DECONTAMINATION

All drilling equipment should be decontaminated before drilling operations begin, between borings, and at completion of the project. The locations for decontamination activities will be designated by the Trust project manager.

Monitoring well casing, screens, and fittings are assumed to be delivered to the site in a clean condition. However, they should be steam cleaned on-site prior to placement downhole. The drilling subcontractor will typically furnish the steam cleaner and water.

After cleaning the drilling equipment, field personnel should place the drilling equipment, well casing and screens, and any other equipment that will go into the hole on clean polyethylene sheeting. The drilling auger, bits, drill pipe, temporary casing, surface casing, and other equipment should be decontaminated by the drilling subcontractor by hosing down with a steam cleaner until thoroughly clean. Drill bits and tools that still exhibit particles of soil after the first washing should be scrubbed with a wire brush and then rinsed again with a high-pressure steam rinse.

All wastewater from decontamination procedures should be containerized.

## 2.3 BOREHOLE SOIL SAMPLING EQUIPMENT DECONTAMINATION

The soil sampling equipment should be decontaminated after each sample as follows:

1. Prior to sampling, scrub the split-barrel sampler and sampling tools in a bucket, containing Liquinox® or Alconox® solution, using a stiff, long bristle brush.
2. Steam clean the sampling equipment over the rinsate tub and allow to air dry or rinse with deionized (distilled) water.
3. Place cleaned equipment in a clean area on plastic sheeting and wrap with aluminum foil.
4. Containerize all water and rinsate.
5. Decontaminate all pipe placed down the hole as described for drilling equipment.

## 2.4 WATER-LEVEL MEASUREMENT EQUIPMENT DECONTAMINATION

Field personnel should decontaminate the well sounder and interface probe before inserting and after removing them from each well. The following decontamination procedures should be used:

1. Wipe the sounding cable with a disposable soap-impregnated cloth or paper towel.
2. Rinse with deionized (distilled) organic-free water.

## 2.5 GENERAL SAMPLING EQUIPMENT DECONTAMINATION

All nondisposable sampling equipment should be decontaminated using the following procedures:

1. Select an area removed from sampling locations that is both downwind and downgradient. Decontamination must not cause cross-contamination between sampling points.
2. Maintain the same level of protection as was used for sampling.
3. If a steam cleaner is not available, to decontaminate a piece of equipment, use an Alconox® wash; a tap water wash; a solvent (methanol or hexane) rinse, if applicable or dilute (0.1 N) nitric acid rinse, if applicable; a distilled water rinse; and air drying. Use a solvent (methanol or hexane) rinse for grossly contaminated equipment (for example, equipment that is not readily cleaned by the Alconox® wash). The dilute nitric acid rinse may be used if metals are the analyte of concern.
4. Place cleaned equipment in a clean area on plastic sheeting and wrap with aluminum foil.
5. Containerize all water and rinsate.

## SOP APPROVAL FORM

## THE PRESIDIO TRUST
## ENVIRONMENTAL STANDARD OPERATING PROCEDURE

## PACKAGING AND SHIPPING SAMPLES

## SOP NO. 015
## REVISION NO. 00

Last Reviewed: December 2000

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12 JAN 01
Date

## 1.0 BACKGROUND

In any sampling program, the integrity of a sample must be ensured from its point of collection to its final disposition. Procedures for classifying, packaging, and shipping samples are described below. Steps in the procedures should be followed to ensure sample integrity and to protect the welfare of persons involved in shipping and receiving samples. When hazardous substances and dangerous goods are sent by common carrier, their packaging, labeling, and shipping are regulated by the U.S. Department of Transportation (DOT) Hazardous Materials Regulations (HMR) (*Code of Federal Regulations*, Title 49 [49 CFR] Parts 106 through 180) and the International Air Transportation Association (IATA) Dangerous Goods Regulations (DGR).

### 1.1 PURPOSE

This standard operating procedure (SOP) establishes the requirements and procedures for packaging and shipping samples. It has been prepared in accordance with the U.S. Environmental Protection Agency (EPA) "Sampler's Guide to the Contract Laboratory Program (CLP)," the DGR, and the HMR. Sample packaging and shipping procedures described in this SOP should be followed for all sample packaging and shipping. Deviations from the procedures in this SOP must be documented in a field logbook. This SOP assumes that samples are already collected in the appropriate sample jars and that the sample jars are labeled and tagged appropriately.

### 1.2 SCOPE

This SOP applies to sample classification, packaging, and shipping.

### 1.3 DEFINITIONS

**Chain of Custody:** Document indicating custody of the samples at all times between sampling and analysis.

**Custody Seal:** A custody seal is a tape-like seal. Placement of the custody seal is part of the chain-of-custody process and is used to prevent tampering with samples after they have been packaged for shipping.

**Dangerous Goods:** Dangerous goods are articles or substances that can pose a significant risk to health, safety, or property when transported by air; they are classified as defined in Section 3 of the DGR (IATA 1999).

**Environmental Samples:** Environmental samples include drinking water, groundwater and surface water, soil, sediment, treated municipal and industrial wastewater effluent, and biological specimens. Environmental samples typically contain low concentrations of contaminants and when handled require only limited precautionary procedures.

**Hazardous Materials Regulations:** The HMRs are DOT regulations for the shipment of hazardous materials by air, water, and land; they are located in 49 CFR 106 through 180.

**Hazardous Samples:** Hazardous samples include dangerous goods and hazardous substances. Hazardous samples shipped by air should be packaged and labeled in accordance with procedures specified by the DGR; ground shipments should be packaged and labeled in accordance with the HMR.

**Hazardous Substance:** A hazardous substance is any material, including its mixtures and solutions, that is listed in Appendix A of 49 CFR 172.101 and its quantity, in one package, equals or exceeds the reportable quantity (RQ) listed in the appendix.

**IATA Dangerous Goods Regulations:** The DGRs are regulations that govern the international transport of dangerous goods by air. The DGRs are based on the International Civil Aviation Organization (ICAO) Technical Instructions. The DGR contain all of the requirements of the ICAO Technical Instructions and are more restrictive in some instances.

**Nonhazardous Samples:** Nonhazardous samples are those samples that do not meet the definition of a hazardous sample and **do not** need to be packaged and shipped in accordance with the DGR or HMR.

**Overpack:** An enclosure used by a single shipper to contain one or more packages and to form one handling unit (IATA 1999). For example, a cardboard box may be used to contain three fiberboard boxes to make handling easier and to save on shipping costs.

## 1.4 REFERENCES

U.S. Department of Transportation, Transport Canada, and the Secretariat of Communications and Transportation of Mexico (DOT and others). 1996. *1996 North American Emergency Response Guidebook.*

International Air Transport Association (IATA). 1997. *Guidelines for Instructors of Dangerous Courses.*

IATA. 1999. *Dangerous Goods Regulations.* 40th Edition.

U.S. Environmental Protection Agency. 1994. "Sampler's Guide to the Contract Laboratory Program." Office of Solid Waste and Emergency Response. Washington, DC. EPA/540/R-96/032. On-Line Address: http://www.epa.gov/oerrpage/superfund/programs/clp/guidance.htm - sample

## 1.5 REQUIREMENTS AND RESOURCES

The procedures for packaging and shipping **nonhazardous** samples require the following:

- Coolers
- Ice
- Vermiculite, bubble wrap, or similar cushioning material
- Chain-of-custody forms and seals
- Airbills
- Resealable plastic bags for sample jars and ice
- Tape (strapping and clear)

The procedures for packaging and shipping **hazardous** samples require the following:

- Ice
- Vermiculite or other noncombustible, absorbent packing material
- Chain-of-custody forms and seals
- Appropriate dangerous goods airbills and emergency response information to attach to the airbill
- Resealable plastic bags for sample jars and ice

- Tape (strapping and clear)
- Appropriate shipping containers, as specified in the DGR
- Labels that apply to the shipment such as hazard labels, address labels, "Cargo Aircraft Only" labels, and package orientation labels (up arrows)

## 2.0 PROCEDURES

The following procedures apply to packing and shipping nonhazardous and hazardous samples.

### 2.1 SAMPLE CLASSIFICATION

Prior to sample shipment by air courier, it must be determined whether the sample is subject to the DGR. Samples subject to these regulations shall be referred to as hazardous samples. Any airline belonging to IATA must follow the DGR. As a result, these air carriers **may not** accept a shipment that is packaged and labeled in accordance with the HMR (although in most cases, the packaging and labeling would be the same for either set of regulations). The HMR states that a hazardous material may be transported by aircraft in accordance with the ICAO Technical Instruction (49 CFR 171.11) upon which the DGR is based. Therefore, the use of the DGR for samples to be shipped by air complies with the HMR, but not vice versa.

Most environmental samples are not hazardous samples and do not need to be packaged in accordance with any regulations. Hazardous samples are those samples that can be classified as specified in Section 3 of the DGR, can be found in the List of Dangerous Goods in the DGR in bold type, are considered a hazardous substance (see definition), or are mentioned in "Section 2 - Limitations" of the DGR for countries of transport or airlines (such as FedEx). The hazard classifications specified in the DGR (and the HMR) are as follows:

Class 1 – Explosives

Division 1.1 – Articles and substances having a mass explosion hazard
Division 1.2 – Articles and substances having a projection hazard but not a mass explosion hazard
Division 1.3 – Articles and substances having a fire hazard, a minor blast hazard, and/or a minor projection hazard but not a mass explosion hazard
Division 1.4 – Articles and substances presenting no significant hazard
Division 1.5 – Very sensitive substances mass explosion hazard

Division 1.6 – Extremely insensitive articles, which do not have a mass explosion hazard

Class 2 – Gases

Division 2.1 – Flammable gas
Division 2.2 – Nonflammable, nontoxic gas
Division 2.3 – Toxic gas

Class 3 – Flammable Liquids

Class 4 – Flammable Solids; Substances Liable to Spontaneous Combustion; Substances, when in Contact with Water, Emit Flammable Gases

Division 4.1 – Flammable solids
Division 4.2 – Substances liable to spontaneous combustion
Division 4.3 – Substances, when in contact with water, emit flammable gases

Class 5 – Oxidizing Substances and Organic Peroxide

Division 5.1 – Oxidizers
Division 5.2 – Organic peroxides

Class 6 – Toxic and Infectious Substances

Division 6.1 – Toxic substances
Division 6.2 – Infectious substances

Class 7 – Radioactive Material

Class 8 – Corrosives

Class 9 – Miscellaneous Dangerous Goods

The criteria for each of the first eight classes are very specific and are outlined in Section 3 of the DGR and 49 CFR 173 of the HMR. Some classes and divisions are further divided into packing groups based on their level of danger. Packing group I indicates a great danger, packing group II indicates a medium danger, and packing group III indicates a minor danger. Class 2, gases, includes any compressed gas being shipped and any noncompressed gas that is either flammable or toxic. A compressed gas is defined as having a pressure over 40 pounds per square inch (psi) absolute (25 psi gauge). Most air samples and empty cylinders that did not contain a flammable or toxic gas are exempt from the regulations. An empty hydrogen cylinder, as in a flame ionization detector (FID), is considered a dangerous good unless it is properly purged with nitrogen in accordance with the HMR. A landfill gas sample is usually considered a

flammable gas because it may contain a high percentage of methane. Class 3, flammable liquids, are based on the boiling point and flash point of a substance. Most class 3 samples include solvents, oil, gas, or paint-related material collected from drums, tanks, or pits. Division 6.1, toxic substances, is based on oral toxicity ($LD_{50}$ [lethal dose that kills 50 percent of the test animals]), dermal toxicity ($LD_{50}$ values), and inhalation toxicity ($LC_{50}$ [lethal concentration that kills 50 percent of the test animals] values). Division 6.1 substances include pesticides and cyanide. Class 7, radioactive material, is defined as any article or substance with a specific activity greater than 70 kiloBecquerels (kBq/kg) (0.002 [microCuries per gram [μCi/g]). If the specific activity exceeds this level, the sample should be shipped in accordance with Section 10 of the DGR. Class 8, corrosives, is based on the rate at which a substance destroys skin tissue or corrodes steel; they are not based on pH. Class 8 materials include the concentrated acids used to preserve water samples. Preserved water samples are not considered class 8 substances and should be packaged as nonhazardous samples. Class 9, miscellaneous dangerous goods, is substances that present a danger, but are not covered by any other hazard class. Examples of class 9 substances include asbestos, polychlorinated biphenyls (PCB), and dry ice.

Unlike the DGR, the HMR includes combustible liquids in hazard class 3. The definition of a combustible liquid is specified in 49 CFR 173.120 of the HMR. The HMR has an additional class, ORM-D, which is not specified in the DGR. "ORM-D material" refers to a material such as a consumer commodity, which although otherwise subject to the HMR, presents a limited hazard during transport due to its form, quantity, and packaging. It must be a material for which exceptions are provided in the table of 49 CFR 172.101. The DGR lists consumer commodities as a class 9 material.

In most instances, the hazard of a material sampled is unknown because no laboratory testing has been conducted. A determination as to the suspected hazard of the sample must be made using knowledge of the site, field observations, field tests, and other available information.

According to 40 CFR 261.4(d) and (e), samples transported to a laboratory for testing or treatability studies, including samples of hazardous wastes, are **not** hazardous wastes. Air carriers will not accept a shipment of hazardous waste.

## 2.2 PACKAGING NONHAZARDOUS SAMPLES

Nonhazardous samples, after being appropriately containerized, labeled, and tagged, should be packaged in the following manner.

1. Place the sample in a resealable plastic bag.

2. Place the bagged sample in a cooler and pack it to prevent breakage.

3. Prevent breakage of bottles during shipment by either wrapping the sample container in bubble wrap, or lining the cooler with a noncombustible material such as vermiculite. Vermiculite is especially recommended because it will absorb any free liquids inside the cooler. It is recommended that the cooler be lined with a large plastic garbage bag before samples, ice, and absorbent packing material are placed in the cooler.

4. Add a sufficient quantity of ice to the cooler to cool samples to 4 °C. Ice should be double bagged in resealable plastic bags to prevent the melted ice from leaking out. As an option, a temperature blank (a sample bottle filled with distilled water) can be included with the cooler.

5. Seal the completed chain-of-custody forms in a plastic bag and tape the plastic bag to the inside of the cooler lid.

6. Tape any instructions for returning the cooler to the inside of the lid.

7. Close the lid of the cooler and tape it shut by wrapping strapping tape around both ends and hinges of the cooler at least once. Tape shut any drain plugs on the cooler.

8. Place two signed custody seals on the cooler, ensuring that each one covers the cooler lid and side of the cooler. Place clear plastic tape over the custody seals.

9. Place address labels on the outside of the cooler, if samples are to be shipped by a commercial carrier.

## 2.2 PACKAGING HAZARDOUS SAMPLES

Packaging of hazardous samples should only be performed by individuals with DOT shipping training. The procedures for packaging hazardous samples are summarized below. Note that according to the DGR, all spellings must be exactly as they appear in the List of Dangerous Goods, and only approved abbreviations are acceptable. The corresponding HMR regulations are provided in parentheses following any DGR references. The HMR must be followed only if shipping hazardous samples by ground transport.

1. Determine the proper shipping name for the material to be shipped. All proper shipping names are listed in column B of the List of Dangerous Goods table in Section 4 of the DGR (or column 2 of the Hazardous Materials Table in 49 CFR 172.101). In most instances, a generic name based on the hazard class of the material is appropriate. For example, a sample of an oily liquid collected from a drum with a high photoionization detector (PID) reading should be packaged as a flammable liquid. The proper shipping name chosen for this sample would be "flammable liquid, n.o.s." The abbreviation "n.o.s." stands for "not otherwise specified" and is used for generic shipping names. Typically, a specific name, such as acetone, should be inserted in parentheses after most n.o.s. descriptions. However, a technical name is not required when shipping a sample for testing purposes and the components are not known. If shipping a hazardous substance (see definition), then the letters "RQ" must appear in front of the proper shipping name.

2. Determine the United Nations (UN) identification number, class or division, subsidiary risk if any, required hazard labels, packing group, and either passenger aircraft or cargo aircraft packing instructions based on the quantity of material being shipped in one package. This information is provided in the List of Dangerous Goods (or Hazardous Materials Table in 49 CFR 172.101) under the appropriate proper shipping name. A "Y" in front of a packing instruction indicates a limited quantity packing instruction. If shipping dry ice or a limited quantity of a material, then UN specification shipping containers do not need to be used.

3. Determine the proper packaging required for shipping the samples. Except for limited quantity shipments and dry ice, these UN specification packages have been tested to meet the packing group of the material being shipped. Specific testing requirements of the packages are listed in Section 6 of the DGR (or 49 CFR 178 of the HMR). All UN packages are stamped with the appropriate UN specification marking. Prior planning is required to have the appropriate packages on hand during a sampling event where hazardous samples are anticipated. Most samples can be shipped in either a 4G fiberboard box, a 1A2 steel drum, or a 1H2 plastic drum. Drums can be purchased in 5- and 20-gallon sizes and are ideal for shipping multiple hazardous samples. When FedEx is used to ship samples containing PCBs, the samples must be shipped in an inner metal packaging (paint can) inside a 1A2 outer steel drum. This method of packaging PCB samples is in accordance with FedEx variation FX-06, listed in Section 2 of the DGR.

4. Place each sample jar in a separate resealable plastic bag. Some UN specification packages contain the sample jar and plastic bag to be used when shipping the sample.

5. Place each sealed bag inside the approved UN specification container (or other appropriate container if a limited quantity or dry ice) and pack with enough noncombustible, absorbent, cushioning material (such as vermiculite) to prevent breakage and to absorp liquid.

6. Place chain-of-custody forms in a resealable plastic bag and either attach it to the inside lid of the container or place it on top inside the container. Place instructions for returning the container to the shipper on the inside lid of the container as appropriate. Close and seal the shipping container in the manner appropriate for the type of container being used.

7. Label and mark each package appropriately. All irrelevant markings and labels need to be removed or obliterated. All outer packaging must be marked with proper shipping name, UN identification number, and name and address of the shipper and the recipient. For carbon dioxide, solid (dry ice), the net weight of the dry ice within the package needs to be marked on the outer package. For limited quantity shipments, the words "limited quantity" or "LTD. QTY." must be marked on the outer package. Affix the appropriate hazard label to the outer package. If the material being shipped contains a subsidiary hazard, then a subsidiary hazard label must also be affixed to the outer package. The subsidiary hazard label is identical to the primary hazard label except that the class or division number is not present. It is acceptable to obliterate the class or division marking on a primary hazard label and use it as the subsidiary hazard label. If using cargo aircraft only packing instructions, then the "Cargo Aircraft Only" label must be used. Package orientation labels (up arrows) must be placed on opposite sides of the outer package. Figure 1 depicts a properly marked and labeled package.

8. If using an overpack (see definition), mark and label the overpack and each outer packaging within the overpack as described in step 7. In addition, the statement "INNER PACKAGES COMPLY WITH PRESCRIBED SPECIFICATIONS" must be marked on the overpack.

9. Attach custody seals, and fill out the appropriate shipping papers as described in Section 2.4.

## 2.4 SHIPPING PAPERS FOR HAZARDOUS SAMPLES

A "Shippers Declaration for Dangerous Goods" and "Air Waybill" must be completed for each shipment of hazardous samples. Air carriers generally supply a their own Dangerous Goods Airbill to their customers; the airbill typically combines both the declaration and the waybill. An example of a completed Dangerous Goods Airbill is depicted in Figure 2. A shipper's declaration must contain the following:

- Name and address of shipper and recipient
- Air waybill number (not applicable to the HMR)
- Page ___ of ___
- Deletion of either "Passenger and Cargo Aircraft" or "Cargo Aircraft Only," whichever does not apply
- Airport or city of departure
- Airport or city of destination
- Deletion of either "Non-Radioactive" or "Radioactive," which ever does not apply

- The nature and quantity of dangerous goods. This includes the following information in the following order (obtained from the List of Dangerous Goods in the DGR): proper shipping name, class or division number, UN identification number, packing group number, subsidiary risk, quantity in liters or kilograms (kg), type of packaging used, packing instructions, authorizations, and additional handling information. Authorizations include the words "limited quantity" or "LTD. QTY." if shipping a limited quantity, any special provision numbers listed in the List of Dangerous Goods in the DGR, and the variation "USG-14" when a technical name is required after the proper shipping name but not entered because it is unknown.

- Signature for the certification statement

- Name and title of signatory

- Place and date of signing certification

- A 24-hour emergency response telephone number for use in the event of an incident involving the dangerous good

- Emergency response information attached to the shipper's declaration. This information can be in the form of a material safety data sheet or the applicable North American Emergency Response Guidebook (NAERG; DOT 1996) pages. Figure 3 depicts the appropriate NAERG emergency response information for "Flammable liquids, n.o.s." as an example.

Note that dry ice does not require an attached shipper's declaration. However, the air waybill must include the following on it: "Dry ice, 9, UN1845, ____ x ____ kg." The blanks must include the number of packages and the quantity in kg in each package. If using FedEx to ship dry ice, the air waybill includes a box specifically for dry ice. Simply check the appropriate box and enter in the number of packages and quantity in each package.

The HMR requirements for shipping papers are located in 49 CFR 172 Subpart C.

## 3.0 POTENTIAL PROBLEMS

The following potential problems may occur during sample shipment:

- Leaking package. If a package leaks, the carrier may open the package, return the package, and if a dangerous good, inform the Federal Aviation Administration (FAA), which can result in fines.

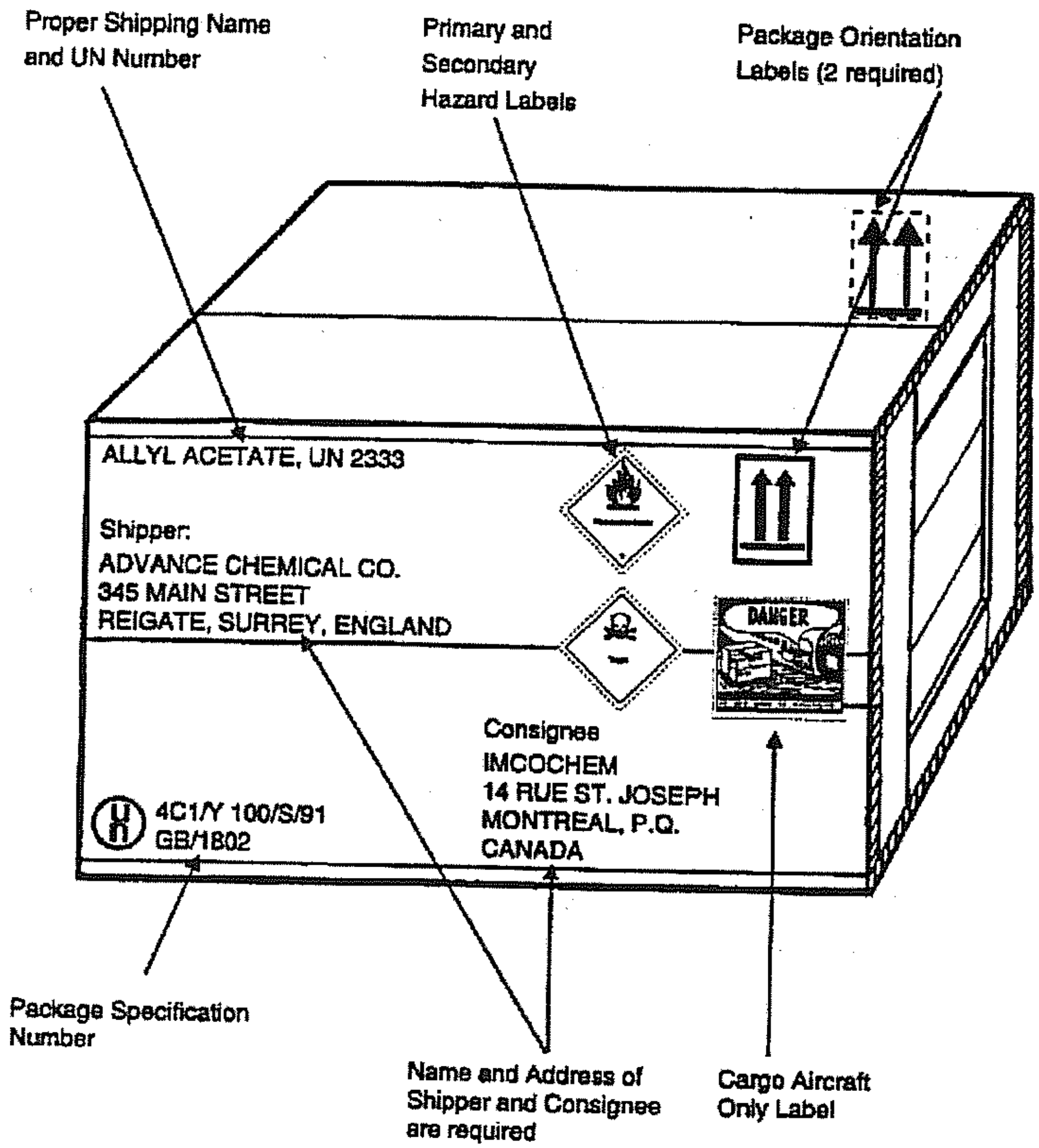
- Improper labeling and marking of package. If mistakes are made in labeling and marking the package, the carrier will most likely notice the mistakes and return the package to the shipper, thus delaying sample shipment.

- Improper, misspelled, or missing information on the shipper's declaration. The carrier will most likely notice this as well and return the package to the shipper.

Contact the air carrier with questions about dangerous goods shipments and ask for a dangerous goods expert.

**FIGURE 1**

**EXAMPLE OF A CORRECTLY MARKED AND LABELED DANGEROUS GOODS PACKAGE**




Source: International Air Transport Association (IATA). 1997.

# FIGURE 2

# EXAMPLE OF A DANGEROUS GOODS AIRBILL

FedEx *Dangerous Goods Airbill*    Sender's Copy

*The World On Time.*

**1 From**
Date: FILL IN    Sender's FedEx Account Number: 1788-8014-4
Sender's Name: FILL IN    Phone: (312) 856 8700
Company: TETRA TECH EM INC
Address: 200 E RANDOLPH ST STE 4700
City: CHICAGO    State: IL    ZIP: 60601

**2** Your Internal Billing Reference: FILL IN

**3 To**
Recipient's Name    Phone
Company
Address
City    State    ZIP

FILL IN

For HOLD at FedEx Location check here: Hold Weekday / Hold Saturday
For WEEKEND Delivery check here: Saturday Delivery / Sunday Delivery

**4a Express Package Service**
[X] FedEx Priority Overnight    [ ] FedEx Standard Overnight
[ ] FedEx 2Day    [ ] FedEx Express Saver

**4b Express Freight Service**
[ ] FedEx 1Day Freight    [ ] FedEx 2Day Freight    [ ] FedEx 3Day Freight

Questions? Call 1·800·Go·FedEx® (800)463-3339 or Visit our Web site at www.fedex.com

**5 Packaging**
[X] Other Packaging
Dangerous Goods cannot be shipped in FedEx packaging.

**6 Special Handling**
[X] Dangerous Goods as per attached Shipper's Declaration    [ ] Cargo Aircraft Only

**7 Payment**
[X] Sender    [ ] Recipient    [ ] Third Party    [ ] Credit Card    [ ] Cash/Check

Total Packages    Total Weight    Total Declared Value $ .00

Signature Release Unavailable

374

FedEx Tracking Number: 813350883058    Form I.D. No. 0204

Page 1 of 1 Pages

*Two completed and signed copies of this Declaration must be handed to the operator.*

**WARNING**
**Failure to comply in all respects with the applicable Dangerous Goods Regulations may be in breach of the applicable law, subject to legal penalties. This Declaration must not, in any circumstances, be completed and/or signed by a consolidator, a forwarder or an IATA cargo agent.**

**TRANSPORT DETAILS**
This shipment is within the limitations prescribed for: PASSENGER AND CARGO AIRCRAFT / ~~CARGO AIRCRAFT ONLY~~
Airport of Departure: Chicago
Airport of Destination: "City sending sample to"

Shipment type: NON-RADIOACTIVE / ~~RADIOACTIVE~~

**NATURE AND QUANTITY OF DANGEROUS GOODS**

| Proper Shipping Name | Class or Division | UN or I.D. No. | Packing Group | Subsidiary Risk | Quantity and Type of Packaging | Packing Inst. | Authorization |
|---|---|---|---|---|---|---|---|
| Flammable liquid, n.o.s. | 3 | UN 1993 | III | — | 4 glass jars in a 1A2 steel drum<br>Net Quantity = 4 L | 309 | A3<br>USG-14 |

Additional Handling Information: NAERG # 128 Attached.

Prepared for AIR TRANSPORT according to: (Customer MUST check one) [ ] 49 CFR [X] ICAO/IATA

I hereby declare that the contents of this consignment are fully and accurately described above by the proper shipping name and are classified, packaged, marked, and labeled/placarded, and are in all respects in proper condition for transport according to applicable international and national governmental regulations.

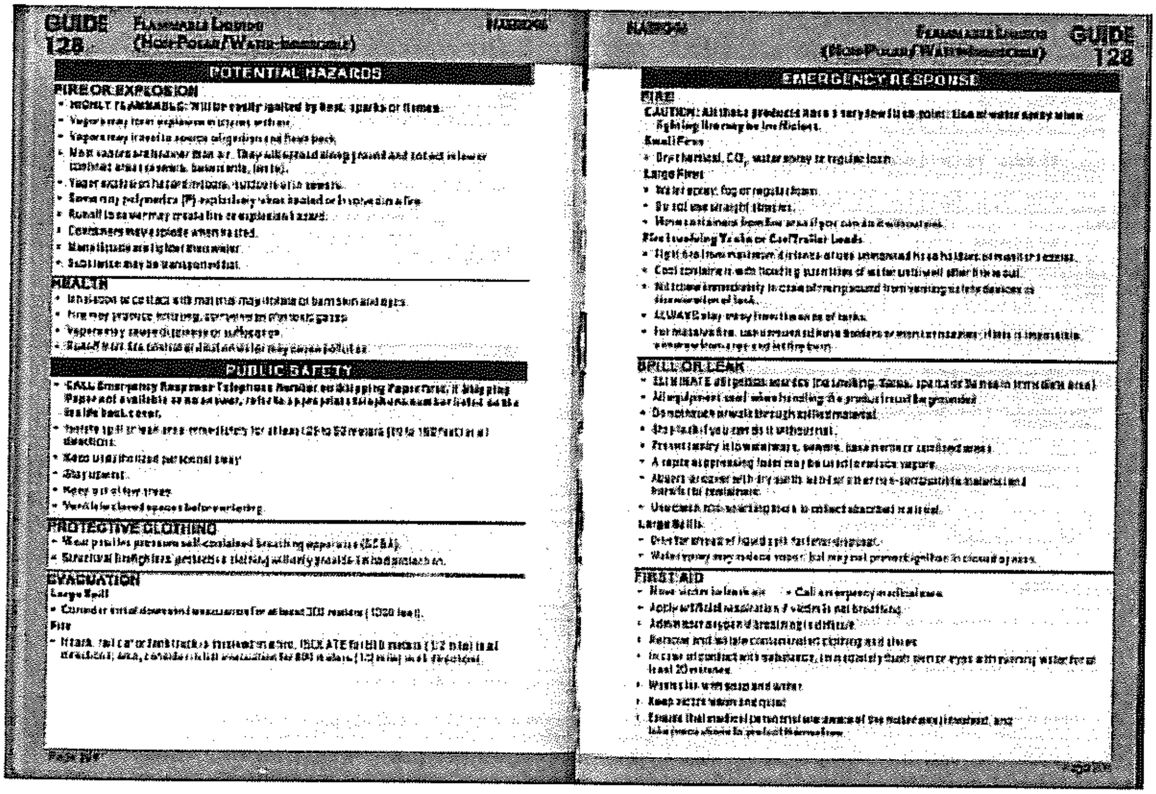
Name/Title of Signatory: Me, Environmental Scientist
Place and Date: 200 E Randolph, Chicago, IL xx/xx/xx
Signature: me

Emergency Telephone Number (Required for U.S. Origin or Destination Shipments): FILL IN

IF ACCEPTABLE FOR PASSENGER AIRCRAFT THIS SHIPMENT CONTAINS RADIOACTIVE MATERIAL INTENDED FOR USE IN, OR INCIDENT TO, RESEARCH, MEDICAL DIAGNOSIS, OR TREATMENT.

# FIGURE 3

## NAERG EMERGECY RESPONSE INFORMATION FOR FLAMMABLE LIQUIDS, N.O.S.



GUIDE 128

POTENTIAL HAZARDS

FIRE OR EXPLOSION

HEALTH

PUBLIC SAFETY

PROTECTIVE CLOTHING

EVACUATION

Large Spill

Fire

GUIDE 128

EMERGENCY RESPONSE

FIRE

Small Fires

Large Fires

SPILL OR LEAK

Large Spills

FIRST AID

Source: DOT and others. 1996.

APPENDIX I

SAMPLING AND ANALYSIS PLAN FOR CORRECTIVE ACTIONS

REVIEWED BY: RR

# CONTENTS



## FIGURE

# I-1.0 INTRODUCTION

This Sampling and Analysis Plan for Corrective Actions (SAP) has been prepared to describe sampling and laboratory analytical procedures for samples to be collected by MACTEC and Treadwell and Rollo (T&R) in support of environmental corrective action field activities described in the Corrective Action Work Plan (Work Plan) for the Building 207/231 Site (Site) at the Presidio of San Francisco (Presidio), California. Building 228 RU indoor air assessment and soil gas sampling protocols are presented in Appendix H of the Work Plan.

Sampling and analysis of soil and groundwater at the Site is intended to properly manage materials generated during corrective actions and provide data to verify cleanup levels have been met for chemicals of concern (COCs) identified at each of the five remedial units (RUs) as described in the *Final Corrective Action Plan, Building 207/231 Area Presidio of San Francisco, California* (CAP; *MACTEC, 2007*). Cleanup level exceedances in soil and groundwater are shown on Figures 1-6 and 1-7 of the Work Plan.

This SAP describes field sampling and analytical procedures that will be implemented during the soil and groundwater corrective actions at the Site.

Specifically, this SAP:

- Documents the project sampling design, analytical methods, target analyte lists, practical quantitation limits, and sampling procedures that will be used to collect data to meet the project objectives; and

- Establishes QC and reporting procedures, so that environmental sampling and analysis meet applicable specifications in accordance with the CAP (*MACTEC, 2007*) and the *Presidio-Wide Quality Assurance Project Plan (QAPP), Sampling and Analysis Plan, Presidio of San Francisco, California* (*TetraTech, 2001*).

## I-1.1 Scope of Corrective Action Sampling

The scope of this SAP is to identify the sampling procedures and protocols to be followed during implementation of the field components of the corrective actions identified in the Work Plan for the Site that consist of: (1) source removal by excavation of contaminated soils and offsite disposal, (2) in-situ treatment of saturated soils and groundwater; (3) groundwater monitoring; and (4) surface water sampling.

Cleanup level exceedances in soil and groundwater are shown on Figures 1-6 and 1-7 of the Work Plan. COCs in soil and groundwater that exceed cleanup levels within each RU are identified in Section I-4.0 (Analytical Methods Summary).

Based on the occurrence of COCs exceeding cleanup levels, the following corrective actions for which sampling will be implemented were identified for the five soil RUs and four co-located groundwater RUs at the Site:

<u>Excavation</u>

- Former Building 207 Soil RU (Including Former Building 208 sump);
- Former Buildings 38, 38-A, and Garage Area Soil RU;
- Building 231 Soil RU; and
- Building 230 Soil RU.

<u>Injection of In Situ Remediation Compounds and Post-Injection In-Situ Sampling</u>

- Building 231 and 228 Soil and Groundwater RUs at the historic wall interface.

<u>HydroPunch Groundwater Sampling During Excavation</u>

- Building 230 Soil RU.

<u>Groundwater Monitoring</u>

- Site-wide monitoring of all Groundwater RUs.

<u>Surface Water Monitoring</u>

- Building 231 RU Surface Water Monitoring.

### I-1.2 Corrective Action Sampling Methodology

Sampling activities that will be conducted as part of the corrective action activities will be guided by the following objectives for (1) excavation; (2) in-situ sampling; and (3) groundwater monitoring as described in the following sections.

### I-1.2.1 Excavation Sampling Methodology

MACTEC will perform excavation sampling using the guidelines and methodology described in the bullets below and in accordance with Section I-2.0 – Sample Process Design.

MACTEC will obtain analytical data directly from the laboratory and perform a preliminary review (EPA Level II Data Validation, see Section I-6.0) of the chemical data and Quality Assurance/Quality Control (QA/QC) data. The sample data will be tabulated and compared to the cleanup levels identified for each RU in Table 1-1 of the Work Plan (Soil Cleanup Levels). The data will be presented during weekly meetings with the National Park Service (NPS), Water Board, and other interested stakeholders. If necessary, the Trust will recommend over-excavation strategies in consultation with the NPS and Water Board and implement the overexcavation strategy agreed upon in the meeting. The over-excavation strategies will be documented in the weekly meetings and performed by the Trust's oversight engineer.

MACTEC in collaboration with the Trust, NPS, Water Board, and other stakeholders will determine how much additional soil will be excavated if cleanup levels are exceeded in confirmation samples collected from the excavation floor or sidewalls based on: (1) the type of contaminant; (2) the magnitude of exceedance relative to cleanup level; (3) the results of field monitoring (if applicable to the COC); and (4) other observations made in the field as to the extent of discoloration, soil type, olfactory evidence, extent of debris, etc. Additional excavation will proceed in no less than 1-foot increments.

Confirmation samples will be collected from the over-excavated area at the same frequency as the confirmation soil samples that were collected from the initial excavation. At a minimum, one floor and three sidewall (perimeter of the over-excavation) samples will be collected from the over-excavated area. Soil samples collected from the over-excavated area will be analyzed for the COC suite associated with the chemical(s) that exceeded cleanup levels in the initial soil confirmation sample. For example, if the initial sample exceeded cleanup levels for lead, then over-excavation samples will be analyzed for metals only.

Figure I-1 (Proposed Excavation Confirmation Sampling Grid) illustrates the Site-wide sampling grid that will be used in the field to identify the soil confirmation sampling locations.

The following guidelines describe in further detail how the confirmation sampling process is anticipated to proceed within the excavation areas.

- If visual observations or photo-ionization detector (PID) readings indicate the presence of contaminated soil in the floor or sidewalls of an excavation, then additional material will be removed until such evidence is no longer present, or until Bay Mud is encountered. Visually contaminated soil may have colors different from the surrounding soil, such as black or green color, or may display a sheen or odor.

- When visual observations or PID readings indicate that contaminated soil has been removed, then confirmation samples will be collected from the floor and sidewalls at the specified frequency and analyzed to confirm that concentrations of COCs are below cleanup levels.

- If laboratory analysis of confirmation samples indicates that no COCs are present in excess of cleanup levels, then no further excavation will be performed on the corresponding floor or sidewall represented by that sample or samples.

- If laboratory analysis of confirmation samples indicates the presence of COCs in excess of cleanup levels, then excavation of the corresponding floor or sidewall will resume. Confirmation samples from expanded excavation areas will only be analyzed for the analytical suite in which the COC detected in the previous confirmation sample exceeded the cleanup levels; the protocol to be used for overexcavation sampling is presented above in Paragraph 4 of this section.

- If laboratory analysis of all corresponding floor and sidewall samples for the expanded excavation indicates that no COCs are present in excess of cleanup levels, or when the excavation cannot be expanded due to the presence of structural constraints, then the excavation will be considered complete.

- If the confirmation samples for the over excavation area exceed the cleanup levels, then MACTEC in collaboration with the Trust, NPS, Water Board, and other stakeholders will determine how much additional soil will be excavated.

- MACTEC in collaboration with the Trust, NPS, Water Board, and other stakeholders will determine the need for collecting additional confirmation samples beyond the minimum specified number of samples. Additional samples may be collected, as necessary, following consultation in weekly stakeholder meetings.

### I-1.2.2 Pre-Construction and In-Situ Sampling Methodology

Pre-Construction and In-Situ Sampling will be conducted as part of corrective actions that will be implemented at the (1) Building 207 RU within the area of Low Temperature Thermal Desorption (LTTD)-treated backfill material; (2) Building 230 RU (during excavation activities); (3) Building 231 RU southern portion at the historic wall interface (prior to in situ injection); and (4) Buildings 231 and 228 RUs at historic wall interface (post-in-situ injection) as described in the Work Plan. Concentrations of COCs in soil will be compared to the cleanup levels identified in Table 1-1 of the Work Plan (Soil Cleanup Levels). Concentrations of COCs in groundwater will be compared to the cleanup levels identified in Table 1-2 of the Work Plan (Groundwater Cleanup Levels).

Prior to excavation at the Building 207 RU, the LTTD treated backfill material will be sampled to verify if concentrations of COCs exist above cleanup levels.

For the Building 230 RU, MACTEC will collect two groundwater HydroPunch samples after excavation is completed from below the excavation bottom (from the intermediate sand below the Bay Mud) prior to backfilling to verify COCs detected in saturated soils above cleanup levels have not impacted groundwater, since groundwater associated with this RU has not been sampled.

For the historic wall interface portion of the Building 231 RU, MACTEC will drill four soil borings and collect soil and HydroPunch samples prior to injection to verify COCs detected in saturated soils above cleanup levels or free product are not present outside of (to the east and west of ) the proposed injection area (see Appendix E for sampling details). The samples will be tested for RU specific COCs and the data will be evaluated prior to implementing in situ remediation, and if concentrations of COCs are detected above cleanup levels in the samples, will be used to refine the remedial design assumptions for in situ remediation prior to injection activities.

For the historic wall interface portions of the Building 231 and 228 RUs where in situ injection will have been performed during pre-construction activities (see Appendix E), MACTEC will collect 12 soil and groundwater samples from each RU approximately two years post-injection after performance monitoring to assess whether COC concentrations detected in saturated soils and groundwater have been reduced below cleanup levels.

T&R will monitor groundwater in the new well pair, 231GW200A/200B, downgradient of the Building 228 RU, over a two year period following injection (quarterly for the first year, semiannually for Year 2,

and annually from Years 3 to 10). In-situ sampling will be conducted in the in situ remediation area at the historic wall interface (the northern portion of Building 228 RU and southern portion of Building 231 RU) approximately two years following completion of injection activities. If RU-related COCs occur at concentrations below cleanup levels in the new well pair following injection, sampling will be ceased at this well.

The following guidelines describe how the in-situ confirmation sampling process is anticipated to proceed to assess the effectiveness of the corrective actions.

- After the corrective action has been implemented, in-situ confirmation samples will be collected from the area using direct push technology (DPT) sampling methods at the specified frequency (to be identified in a separate work plan addendum as described in Section 3.3.7 of the Work Plan) and analyzed to confirm that concentrations of COCs are below cleanup levels.

- If no COCs are present in excess of cleanup levels, then no further corrective actions will be performed on the area represented by that sample or samples, and the corrective action for the area will be considered complete.

The need for additional injection or implementation of other technologies consistent with mitigating or preventing migration of groundwater containing COCs above cleanup levels will also be assessed. Details regarding the need for, implementation, and duration of these contingencies would be described in a supplemental report based on the results of post-injection groundwater monitoring and DPT confirmation sampling. If sampling results indicate concentrations of COCs are below cleanup levels, it is assumed that 'clean closure' of these portions of the Building 228 and 231 RUs would be obtained.

### I-1.2.3 Groundwater Confirmation Sampling Methodology

Groundwater Monitoring will be conducted as summarized in Table 2-1 of the Work Plan (Summary of Groundwater Monitoring and Well Abandonment Program) by the Trust's subcontractor (Treadwell & Rollo) under the existing *Semi-Annual Groundwater Monitoring Report, Presidio-Wide Quarterly Groundwater Monitoring Program*. Concentrations of COCs in groundwater will be compared to the cleanup levels identified in Table 1-2 of the Work Plan (Groundwater Cleanup Levels).

The following guidelines describe how the groundwater monitoring process is anticipated to proceed for the Site-wide network of monitoring wells to assess the effectiveness of the corrective actions.

- If results of laboratory analysis indicate that COCs are below cleanup levels in groundwater for four consecutive quarters in the first year of monitoring, then the sampling frequency will change to semi-annual and the monitoring will continue for two additional years.
- If results of laboratory analysis indicate that COCs are below cleanup levels for four consecutive semi-annual monitoring events following the first year of sampling, the monitoring program will be discontinued, and the remedial action will be considered complete.
- If in the first year of monitoring groundwater does not meet cleanup levels for COCs for four consecutive quarters, then quarterly sampling will continue for up to two years.
- If after up to three years of monitoring, COCs are above cleanup levels in the groundwater samples, the data will be assessed in accordance with the groundwater monitoring program identified in the Work Plan.

#### I-1.2.4 Surface Water Sampling Methodologies

If and when surface expression of groundwater is observed (anticipated to be in late winter and early spring) following backfilling in the Building 231 RU area, surface water sampling will be conducted in the Building 231 RU area by MACTEC. 1 surface water (and a duplicate) sample is proposed and will be tested for RU-specific COCs. The samples will be collected using a bailer and in accordance with the Trust's SOP – 007 – Surface Water Sampling.

# I-2.0 SAMPLE PROCESS DESIGN

This section describes the types of samples to be collected, the sample measurement parameters, and the sample collection process.

## I-2.1 Sample Types

Soil, groundwater, and surface water are the media to be sampled during the project. Field samples and quality assurance /quality control (QA/QC) samples will be generated. Field samples include soil and Hydropunch samples to be collected from soil borings, excavation confirmation samples, soil stockpile samples, groundwater samples collected from down gradient wells, and surface water samples. QA/QC samples are duplicate samples submitted to the laboratory as control elements to verify the accuracy and consistency of analytical results and equipment rinsate samples collected to document the effectiveness of equipment decontamination methods. QA/QC sampling procedures are described further in Section I-6.0 (Quality Control Requirements).

## I-2.2 Sample Measurement Parameters

The remedial unit (RU) specific analytical methods are summarized in Section I-4.0 (Analytical Methods Summary), and for waste profiling in Section I-5.0 (Investigation-Derived Waste).

## I-2.3 Sample Collection Process

The sample collection process to be followed during corrective actions for each of the five RUs are described in the following sections.

### I-2.3.1 Sample Collection Process—Former Building 207 Remedial Unit (Including Former Building 208 Sump)

**LTTD Treated Backfill Sampling:** Prior to excavation at the Building 207 RU, the LTTD treated backfill material will be sampled to verify if concentrations of COCs exist above cleanup levels. Department of Toxic Substances Control (DTSC) Information Advisory for Clean Imported Fill Material (*DTSC, 2001*) was used to estimate the number of samples to be collected for this verification. The DTSC advisory requires 4 samples for the first 1,000 cubic yards of backfill material and 1 sample thereafter for each additional 500 cubic yards. Because, approximately 711 cubic yards of backfill material is estimated to be present in this area, a minimum of 3 samples will be collected at the bottom of this layer and tested for RU-specific COCs (see Figure I-1 for sample locations) (*IT, 1998*).

**Confirmation Sampling:** Two excavations are anticipated at the Former Building 207 RU: within the Former Building 207 Area, and the Former Building 208 Sump Area. As shown on Figure I-1 (Proposed Excavation Confirmation Sampling Grid), a 25- by 25-foot sampling grid will be used to guide the collection of excavation floor (bottom) and sidewall samples. Based on the estimated excavation areas, the following confirmation samples are anticipated to be collected:

- **Floor sampling –** The estimated surface area of the floor of the Former Building 207 Area is approximately 10,000 square feet (sf); one floor sample will be collected per 625 sf (25- by 25-foot). The estimated surface area of the floor of the Former Building 208 Sump Area is approximately 300 sf; a minimum of one floor sample will be collected. If the excavation area exceeds 625 sf, one additional floor sample will be collected per 625 sf (25- by 25-foot).

- **Sidewall sampling –** The excavation sidewalls will be sampled at the midpoint of their height every 25 feet of the excavation's lateral extent. A minimum of one sidewall sample will be collected from each side of the excavations.

- **Groundwater sampling –** Two monitoring wells will be installed down gradient of this RU (New Wells 3 and 4). Following excavation activities, the wells will be sampled in accordance with the groundwater monitoring program described in the Work Plan.

T&R will install and develop the new wells, New Well 3, and New Well 4, following the guidelines set forth in the Presidio-Wide Quality Assurance Project Plan (QAPP); [*Tetra Tech, 2001*] SOP No. 004 and 005 specifically; Appendix F); specifically, it will be installed using a hollow-stem auger rig, constructed with 2-inch diameter schedule 40 polyvinyl chloride (PVC) casing, and a 2-inch diameter 0.010 slotted casing with 2/12 sand.

New Well 3 and New Well 4 are anticipated to be both screened from approximately 5 to 20 feet bgs, respectively. However, the actual screen intervals will be determined following completion of excavation and in consultation with the NPS, Trust, Water Board, and other stakeholders. The location and elevation will be surveyed by a licensed land surveyor to within ±0.01 foot accuracy in accordance with survey requirements in Section 3.1.9 of the Work Plan.

### I-2.3.2 Sample Collection Process—Former Building 38, 38-A and Garage Area Remedial Unit

Two excavations are anticipated at the Former Building 38 RU, on the southern and northern sides of the Doyle Drive overpass structure. As shown on Figure I-1 (Proposed Excavation Confirmation Sampling Grid), a 25- by 25-foot sampling grid will be used to guide the collection of excavation floor (bottom) and sidewall samples. Based on the estimated excavation area at the Former Building 38 RU, the following confirmation samples are anticipated to be collected:

- **Floor sampling –** The estimated surface area of the floors of the excavations are approximately 300 and 600 sf. A minimum of one floor sample will be collected within each of the excavations. If the excavations exceed 625 sf, a 25- by 25-foot sampling grid will be used to guide collection of excavation bottom samples.

- **Sidewall sampling –** The excavation sidewalls will be sampled at the midpoint of their height every 25 feet of the excavation's lateral extent. A minimum of one sidewall sample will be collected from each side of the excavations.

- **Groundwater sampling –** T&R will install two monitoring wells down gradient of this RU (New Wells 5 and 6). Screen intervals are anticipated to be from approximately 5 to 20 feet bgs. Actual screen intervals will be determined following completion of excavation and in consultation with NPS, Trust, Water Board, and stakeholders. Following excavation activities, the wells will be sampled in accordance with the groundwater monitoring program described in the Work Plan.

### I-2.3.3 Sample Collection Process — Building 231 Remedial Unit

**Pre Injection Sampling:** For the historic wall interface portion of the Building 231 RU, MACTEC will drill four soil borings and collect soil and HydroPunch samples at 3 and 8 feet bgs prior to injection to verify COCs detected in saturated soils above cleanup levels or free product are not present outside of (to the east and west of ) the proposed injection area as shown on Figure I-1 (see Appendix E for sampling details). The samples will be tested for RU specific COCs and the data will be evaluated prior to implementing in situ remediation, and if concentrations of COCs are detected above cleanup levels in the samples, will be used to refine the remedial design assumptions for in situ remediation prior to injection activities.

**Confirmation Sampling:** One excavation is anticipated at the Former Building 231 RU. As shown on Figure I-1 (Proposed Excavation Confirmation Sampling Grid), a 25- by 25 foot sampling grid will be used to guide the collection of excavation floor (bottom) and sidewall samples. Based on the large size of the estimated excavation area at the Building 231 RU, the following confirmation samples are anticipated to be collected:

- **Floor sampling –** The estimated surface area of the floor of the excavation is approximately 28,000 sf; one floor sample will be collected per 625 sf (25- by 25-foot).
- **Sidewall sampling –** The excavation sidewall will be sampled at the midpoint of its height every 25 feet of its lateral extent.
- **Groundwater sampling –** T&R will install one monitoring well down gradient of this excavation (New Well 2). Screen interval is anticipated to be from approximately 5 to 20 feet bgs. Actual screen intervals will be determined following completion of excavation and in consultation with NPS, Trust, Water Board, and stakeholders. Following excavation activities, the well will be sampled in accordance with the groundwater monitoring program described in the Work Plan.
- **Surface Water Sampling:** If and when surface expression of groundwater is observed (anticipated to be in late winter and early spring) following backfilling, surface water sampling will be conducted in the Building 231 RU area by MACTEC. 1 surface water (and a duplicate) sample is proposed and will be tested for RU-specific COCs.

### I-2.3.4 Sample Collection Process—Building 230 Remedial Unit

One excavation is anticipated at the Former Building 230 RU. As shown on Figure I-1 (Proposed Excavation Confirmation Sampling Grid), a 25- by 25-foot sampling grid will be used to guide the collection of excavation floor (bottom) and sidewall samples. Based on the estimated excavation area at the Building 230 RU, the following confirmation samples are anticipated to be collected:

- **Floor sampling –** The estimated surface area of the excavation floor is approximately 1,800 sf; one floor sample will be collected per 625 sf (25- by 25-foot).
- **Sidewall sampling –** The excavation sidewall will be sampled at the midpoint of its height every 25 feet of its lateral extent.

- **Groundwater sampling –** After excavation is complete, soil confirmation samples have been collected, and prior to backfilling, HydroPunch groundwater samples will be collected to the north and south of the excavation limit to verify there are no residual groundwater impacts in the area of this RU. Following the HydroPunch sampling, the existing monitoring well down gradient of this excavation (231GW11) will be sampled in accordance with the groundwater monitoring program described in the Work Plan.

### I-2.3.5 Sample Collection Process—Historic Wall Interface

The corrective action for the historic wall interface (northern portion of the Building 228 RU and southern portion of the Building 231 RU) includes in situ injection of remediation compounds. The following confirmation samples are anticipated to be collected from within these portions of the RUs after implementation of the corrective action, and will be described and documented in a Letter Report or Addendum to the Construction Completion Report, depending on the implementation schedule:

- **Groundwater sampling –** A monitoring well pair was installed down gradient of the ORC injection area (231GW200A/200B) in January 2008 by T&R. Two rounds of baseline sampling will be conducted (first round in the first quarter 2008 and a second round approximately one months prior to ORC injection); these samples will be analyzed on a rush turn around basis. Post remediation sampling (quarterly during the first year, semi-annual during year 2, and annual during years 3 to 10) will be conducted at this well. If RU related COCs reduce below cleanup levels in this well following injection, sampling will be ceased at this well.

- **In-Situ soil and groundwater sampling –** The effectiveness of the in situ remediation in reducing groundwater COCs below cleanup levels will be assessed (1) during groundwater monitoring of down gradient wells for COCs over a 2-year period following injection, and (2) approximately 2 years post-injection by collecting in-situ soil confirmation samples and in-situ groundwater confirmation samples from both portions of the RUs using direct push technology (DPT).

An assessment of potential vapor phase intrusion to indoor air and inspection of the indoor cap and building foundation will be performed by EKI at Building 228. The assessment will be implemented in accordance with DTSC/Cal EPA's *Interim Final Guidance for the Evaluation and Mitigation of Subsurface Vapor Intrusion to Indoor Air,* December 15, 2004, revised February 7, 2005. The plan for

this assessment is included in Appendix H of the Work Plan. The results of the assessment and corrective actions implemented, if necessary, will be documented in the Construction Completion Report.

The in situ remediation field activities will be described in the Construction Completion Report. The post remediation groundwater monitoring to be conducted by T&R will be reported in the Semi Annual Groundwater Monitoring Reports by T&R. For the in situ confirmation sampling to be conducted at the historic wall interface approximately two years after injection, MACTEC will prepare a Work Plan prior to the field work and a report describing the confirmation sampling after completion of the field work for approval by the Water Board and the stakeholders.

# I-3.0 SAMPLING METHOD REQUIREMENTS

Sampling procedures will be performed in accordance with protocols described in detail in the QAPP, and summarized in the following sections.

## I-3.1 Sample Collection

Samples will be collected in accordance with the Presidio Trust Standard Operating procedures (SOPs), specifically SOP No. 001 of the QAAP (*TetraTech, 2001*) (SOPs can be found in Appendix F of the Work Plan).

Confirmation soil samples will be collected from excavation floors and sidewalls at the frequencies described in Section I-2.0 using a drive-sampler lined with stainless-steel sample tubes, an EnCore sampler or another 5035 approved sampling product, or from a backhoe bucket, depending on field conditions, accessibility, and analytical container requirements. If samples are collected from a backhoe bucket, the sample collector will direct the operator and observe the process as the bucket is filled to verify that the material is representative of in-situ soil from the targeted sample location. A sample tube will be pushed or driven sufficiently into the soil in the bucket so the sample tube is completely filled to minimize voids or headspace that may contribute to subsequent volatilization of COCs. Following collection, sample containers will be appropriately sealed and submitted to the analytical laboratory for analysis of COCs as described in Section I-3.0 (Sampling Method Requirements).

Discrete samples will be collected from excavated stockpiled soil or imported backfill using a hand sampler, backhoe bucket, or following the protocols described above. In situ samples will be collected using best available direct push technology (DPT) sampling methods specific to the equipment selected, and will be described in the Construction Completion Report.

A licensed land surveyor under contract with the excavation contractor will survey the confirmation sample locations; these locations will be presented by the land surveyor on the excavation record survey map, which will document the topographic condition following the completion of excavation.

Groundwater samples will be collected during monitoring as summarized in Table 2-1 of the Work Plan (Summary of Groundwater Monitoring and Well Abandonment Program). Groundwater samples will be collected in accordance with groundwater sampling procedures described in the QAPP and the Trust's *Semi-Annual Groundwater Monitoring Report, Presidio-Wide Quarterly Groundwater Monitoring*

*Program*. Samples will be collected in containers appropriate for the analyses requested, and submitted to the laboratory for evaluation of COCs as described in Section I-3.0 (Sampling Method Requirements).

Surface water samples will be collected in the Building 231 RU following completion of backfilling using a bailer and in accordance with the Trust's SOP – 007 – Surface Water Sampling.

#### I-3.1.1 Sampling Equipment Decontamination

Decontamination of all reusable sampling equipment will be performed before initial use onsite and between each use at discrete sample locations. Decontamination will be performed in accordance with specifications in the QAPP. MACTEC's field crew will be provided copies of the specific sections of the QAPP that document the procedures to be followed for equipment decontamination.

### I-3.2 Sample Documentation and Handling

The excavation contractor and Engineering field personnel are responsible for documentation of field activities, conditions, sample locations, labeling, packaging, storage, handling, and shipping, if applicable, of samples collected in the field. These practices are necessary to maintain the integrity of the sampling process and the sample from initial collection through reporting. The following sections describe the documentation and handling processes that will be used.

#### I-3.2.1 Sample Labels

All samples will be appropriately labeled so they can be identified and correlated with the source location. Information will be printed legibly with waterproof ink. The label must contain sufficient information so that the sample can be correlated with field logs, sample collection logs, and chain-of-custody forms. Each sample label will contain the following information:

- Project name;
- Unique sample identifier as described in Section I-3.2.2 (Sample Numbering System);
- Date and time of sample collection;
- Remarks as needed; and
- Initials or name of the sampler.

### I-3.2.2 Sample Numbering System

Every sample collected will carry a unique identification number. The sample designation will facilitate data management by referencing sample type, location and the depth. Identification numbers consist of an alphanumeric code that sequentially provides the appropriate reference information in the format of site designation, sample type, three-digit numerical sequence of sample, and depth below ground surface in brackets.

Excavation Confirmation Samples:

For example, the sample identification number 231EX100[5] would refer to the following:

- 231 – The sample is from the Building 231 Area.
- EX – The sample source location is the excavation and it is an excavation confirmation sample.
- 100 – The unique sequential sample number for this sample is 100. The project sample numerical sequence will begin with sample number 100, which indicates that this was the first field sample collected for the project.
- [5] – The sample was collected from a location within the excavation that was at a depth of 5 feet below the previous ground surface, the previous ground surface will be determined using reference stakes that were set up prior to the excavation.

HydroPunch Samples:

For example, the sample identification number 230HP100[15] would refer to the following:

- 231 – The sample is from the Building 230 Area.
- HP – HydroPunch.
- 100 – The unique sequential sample number for this sample is 100. The project sample numerical sequence will begin with sample number 100, which indicates that this was the first field sample collected for the project.
- [15] – The sample was collected at a depth of 15 feet below ground surface.

Soil Boring Samples:

For example, the sample identification number 230SB100[15] would refer to the following:

- 230 – The sample is from the Building 230 Area.
- SB – Soil Boring.
- 100 – The unique sequential sample number for this sample is 100. The project sample numerical sequence will begin with sample number 100, which indicates that this was the first field sample collected for the project.
- [15] – The soil sample was collected at a depth of 15 feet below ground surface.

Surface Water Samples:

For example, the sample identification number 231SW100 would refer to the following:

- 231 – The sample is from the Building 231 Area.
- SW – Surface Water.
- 100 – The unique sequential sample number for this sample is 100. The project sample numerical sequence will begin with sample number 100, which indicates that this was the first field sample collected for the project.

Backfill Sample:

For example, the sample identification number 231BC100 would refer to the following:

- 231 – The sample is from the Building 231 Area.
- BC – Backfill Composite
- 100 – The unique sequential sample number for this sample is 100. The project sample numerical sequence will begin with sample number 100, which indicates that this was the first field sample collected for the project.

Extracted Water Sample:

For example, the sample identification number 231DE100 would refer to the following:

- 231 – The sample is from the Building 231 Area.
- DE– Dewatering Sample
- 100 – The unique sequential sample number for this sample is 100. The project sample numerical sequence will begin with sample number 100, which indicates that this was the first field sample collected for the project.

Duplicate Samples:

Duplicate samples and trip blanks will have the source code (“DUP” or “TB”, as appropriate) followed by the date. For example, sample number DUP021507 indicates a duplicate sample that was collected on February 15, 2007. MACTEC and the Trust will confirm that each duplicate sample collected in the field has a unique identification number. If more than one duplicate sample is collected on a single date, then the sample number will also include the suffix “-1”, or “-2”, etc., to differentiate the duplicate samples from that day (e.g., DUP021507-2 indicates the second of two duplicate samples collected on that date). Field logs and sample collection logs will also indicate the source location of the duplicate sample for correlation purposes. MACTEC and the Trust will coordinate with the Trust’s database manager to confirm that the duplicate samples collected are being assigned unique identification numbers. Where the duplicate samples are to be collected, to the extent practicable, the duplicate sample will be collected adjacent to the primary sample. The top of each sampling sleeve will be marked in the field and further, the analytical laboratory will be instructed to sample from the top of the sampling sleeves.

Equipment Blank Samples:

Equipment blanks will include the number of the primary sample collected, followed by the designation “RB”, in turn followed by the number of the primary sample collected after the equipment blank is collected. For example, an equipment blank collected after the collection of sample number 231EX100[5], would have the sample number 231EX100RB101, indicating that it was collected between samples 100 and 101. Note that an equipment blank collected after the last primary sample of the day would not have a following sample designation and would end with “RB” (e.g., 231EX100RB).

Prior to field mobilization, MACTEC will prepare a sampling and analysis plan, which includes a list of samples and sample identification number for approval by the Trust's database manager.

### I-3.2.3 Sample Packaging and Shipping

After collection and labeling, samples will be placed in refrigerated containers and transported to the analytical laboratory by the laboratory courier, or shipped through a parcel delivery service, depending on the location of the laboratory. The following steps will be taken before the sample containers are transported.

- Make sure all sample container caps are tight;
- Place samples in sealed, water-tight plastic bags;
- Place enough ice in samples to maintain samples at 4 degrees C or less; and
- Place sufficient packing material in the container to minimize the potential for breakage of samples.

The chain-of-custody form will be appropriately signed by the Engineer relinquishing the samples and the laboratory personnel receiving the samples. If samples are to be shipped via a parcel delivery service, the following steps will also be taken:

- Place the top page of each chain-of-custody form in a sealed clear plastic envelope in the cooler; and
- Secure the container closure and place a custody seal over the container lid.

#### I-3.2.3.1 Chain of Custody Documentation

Sample chain-of-custody documentation must be complete and thoroughly maintained from initial sampling to completion of analysis and reporting to verify sample integrity. Documentation procedures will be in accordance with the protocols described in the QAPP, and will include all required information. Documentation will also include acceptance and relinquishment signatures for all persons through whose custody the samples have passed.

### I-3.3 Quality Assurance and Quality Control Sampling

QA/QC samples will be included in this project to support the data quality objectives presented in Section I-2.0 (Sample Process Design). The sampling methodologies, preservation techniques, and decontamination procedures have been selected to confirm appropriate data quality. In order to meet project objectives, field duplicates, and matrix spike/matrix spike duplicate (MS/MSD) samples will be collected at a frequency of approximately 10 percent of the total number of samples generated for each removal activity. For groundwater samples collected from wells, or for soil samples that are collected in sample tubes and EnCore type samplers, MS/MSD additional sample volumes will be generated by collecting two additional sample volumes from the designated sample points.

In accordance with the QAPP, the equipment blank samples will be collected each sampling day, but not to exceed 10 percent of the total number of primary samples. MACTEC will maintain a sample tracking form (included in Appendix G), which tracks all the samples collected (primary and QC samples) and the equipment blank samples. The tracking will allow MACTEC to confirm that the QAPP requirements are met.

Trip blanks will be submitted at a frequency of one per shipped sample container containing groundwater samples, not to exceed 10 percent of the total number of primary water samples.

# I-4.0 ANALYTICAL METHODS SUMMARY

This section lists the analytical suites for the proposed work at each of the Soil and Groundwater RUs identified at the Site. Samples will be submitted to an analytical laboratory that is State-certified for the analyses requested.

## I-4.1 Analytical Methods—Former Building 207 Remedial Unit (Including Former Building 208 Sump)

The LTTD treated backfill material and soil confirmation samples collected from the Building 207 RU will be analyzed for the analytical suite associated with each COC previously determined to exceed cleanup levels in the vicinity of the confirmation sample, including the following analytes:

- Title 22 Metals by EPA Test Method Series 6010/6020-7000 (Lead);
- MTBE and BTEX by EPA Test Method 8260B; and
- TPHs by EPA Test Method 8015 with specified carbon range (which includes TPH as gasoline, diesel, and fuel oil).

The soil confirmation samples collected from the Former Building 208 Sump RU will be analyzed for the full analytical suite associated with each COC including the following analytes:

- TPHs by EPA Test Method 8015 with specified carbon range (which includes TPH as gasoline [C7 to C12], diesel [C12 to C24], and fuel oil [C24 to C36]). TPH diesel and fuel oil analysis will be conducted using silica gel cleanup.
- Title 22 Metals by EPA Test Method Series 6010/6020-7000 (Lead and Zinc).
- PAHs by EPA Test Method 8270SIM (benzo(a)pyrene).

The groundwater confirmation samples collected from the Building 207 RU will be analyzed for the full analytical suite associated with each COC, including the following analytes:

- TPHs by EPA Test Method 8015 with specified carbon range (which includes TPH as gasoline [C7 to C12]);
- MTBE and BTEX by EPA Test Method 8260B;

- PAHs by EPA Test Method 8270SIM (which includes the COCs benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(b+k)fluoranthene, benzo(k)fluoranthene, chrysene and indeno(1,2,3-cd)pyrene);
- Redox and DO by direct reading field measurement; and
- General water quality parameters by various methods.

### I-4.2 Analytical Methods—Former Building 38, 38-A, and Garage Area Remedial Unit

The soil confirmation samples collected from the Building 38 RU will be analyzed for the analytical suite associated with each COC previously determined to exceed cleanup levels in the vicinity of the confirmation sample, including the following analytes:

- TPHs by EPA Test Method 8015 with specified carbon range (which includes TPH as diesel and fuel oil using silica gel cleanup);
- Title 22 Metals by EPA Test Method Series 6010/6020-7000 (Arsenic, Lead and Zinc); and
- PAHs by EPA Test Method 8270SIM (which includes the COCs anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(b+k)fluoranthene, benzo(k)fluoranthene, chrysene, fluoranthene, phenanthrene, and pyrene).

The groundwater confirmation samples collected from the Building 38 RU will be analyzed for the full analytical suite associated with each COC, including the following analytes:

- VOCs by EPA Test Method 8260B (which includes the COC toluene and vinyl chloride);
- Title 22 Metals by EPA Test Method Series 6010/6020-7000 (Arsenic and Nickel);
- PAHs by EPA Test Method 8270SIM (which includes the COCs benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(b+k)fluoranthene, benzo(k)fluoranthene, chrysene and indeno(1,2,3-cd)pyrene);
- Redox and DO by direct reading field measurement; and
- General water quality parameters by various methods.

### I-4.3 Analytical Methods—Building 231 Remedial Unit

The pre-injection soil samples and soil confirmation samples collected from the Building 231 RU will be analyzed for the analytical suite associated with each COC previously determined to exceed cleanup levels in the vicinity of the confirmation sample, including the following analytes:

- TPHs by EPA Test Method 8015 with specified carbon range (which includes TPH as gasoline, diesel and fuel oil using silica gel cleanup).
- VOCs by EPA Test Method 8260B (which includes the COCs BTEX, Methylene chloride (MeCl), PCE, and vinyl chloride);
- Title 22 Metals by EPA Test Method Series 6010/6020-70 (which includes the COCs arsenic, chromium, cobalt, lead, mercury, nickel, silver, and zinc);
- PAHs by EPA Test Method 8270SIM (which includes the COCs benzo(a)pyrene, benzo(b)fluoranthene, and benzo(b+k)fluoranthene); and
- Pesticides and PCBs by EPA Test Method 8081A and 8082 (which includes the COCs 4,4'- DDT and Arochlor 1016).

The pre-injection groundwater samples and groundwater confirmation samples collected from the Building 231 RU will be analyzed for the full analytical suite associated with each COC, including the following analytes:

- TPHs by EPA Test Method 8015 with specified carbon range (which includes TPH as gasoline, diesel, and fuel oil);
- VOCs by EPA Test Method 8260B (which includes the COC BTEX, bromobenzene, 1,2-DCA, PCE, and TCE);
- Title 22 Metals by EPA Test Method Series 6010/6020-7000 (Lead, vanadium, zinc, and Nickel);
- PAHs by EPA Test Method 8270SIM (which includes the COCs benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(b+k)fluoranthene, benzo(k)fluoranthene, and chrysene);

- PCBs by EPA Test Method 8082 (which includes the COC Arochlor 1016);
- Redox and DO by direct reading field measurement; and
- General water quality parameters by various methods.

### I-4.4 Analytical Methods—Building 230 Remedial Unit

The soil confirmation samples collected from the Building 230 RU will be analyzed for the full analytical suite associated with each COC, including the following analytes:

- TPHs by EPA Test Method 8015 with specified carbon range (which includes TPH as diesel and fuel oil using silica gel cleanup);
- Title 22 Metals by EPA Test Method Series 6010/6020-7000 (Lead); and
- PAHs by EPA Test Method 8270SIM (which includes the COCs acenaphthylene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(b+k)fluoranthene, and pyrene).

The surface water and groundwater confirmation samples collected from the Building 230 RU will be analyzed for the full analytical suite associated with each COC, including the following analytes:

- TPHs by EPA Test Method 8015 with specified carbon range (which includes TPH as diesel, and fuel oil);
- Title 22 Metals by EPA Test Method Series 6010/6020-7000 (Lead);
- PAHs by EPA Test Method 8270SIM (which includes the COCs acenaphthylene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(b+k)fluoranthene, and pyrene);
- Redox and DO by direct reading field measurement; and
- General water quality parameters by various methods.

In addition, the surface water samples will also be tested for pesticides using EPA 8081.

### I-4.5 Analytical Methods—Historic Wall Interface

The soil confirmation samples collected from the Building 2228 and 231 RUs at the historic wall interface will be analyzed for the full analytical suite associated with each COC, including the following analytes:

- TPHs by EPA Test Method 8015 with specified carbon range (which includes TPH as gasoline, diesel and fuel oil using silica gel cleanup); and
- VOCs by EPA Test Method 8260B (which includes the COCs ethylbenzene and xylenes).

The groundwater confirmation samples collected from the well located at the historic wall interface will be analyzed for the full analytical suite associated with each COC, including the following analytes:

- TPHs by EPA Test Method 8015 with specified carbon range (which includes TPH as gasoline, diesel, and fuel oil);
- VOCs by EPA Test Method 8260B (which includes the COCs ethylbenzene, 1,2-dichlorobenzene, and xylenes);
- Title 22 Metals by EPA Test Method Series 6010/6020-7000 (which includes COCs nickel and arsenic[for a minimum of one year]);
- Redox and DO by direct reading field measurement; and
- General water quality parameters by various methods.

### I-4.6 Excavation Waste Profiling

Excavated soil will require sampling and analysis to fulfill profiling and characterization requirements of the appropriately-licensed landfills or recycling facilities at which the material will be disposed. Sampling frequencies and analyses will be based on the requirements of the disposal facility, but will include, as a minimum, analysis for all site COCs.

# I-5.0 INVESTIGATION-DERIVED WASTE

For sampling to be conducted during soil excavation (i.e., confirmation sampling and stockpile sampling), the sampling related waste will be placed in the soil stockpiles and disposed off-site along with the excavation spoils. Decontamination, purge, or equipment rinsate water generated during soil removal activities will be transferred to the onsite storage tanks (Baker tanks) used to store extracted groundwater. The discharge of extracted water from the tanks will be handled in accordance with Appendix C of this Work Plan.

For in-situ and groundwater sampling to be conducted prior to and after completion of excavation activities, the IDW generated will be contained and sealed in 55-gallon drums and transferred to the Central Magazine area, where it will be profiled. Soil waste will be transported off-site to appropriate landfill facilities and groundwater (provided it meets Trust's industrial wastewater permit requirements) will be discharged into the sanitary sewer system.

# I-6.0 DATA VALIDATION AND DATA MANAGEMENT

MACTEC will obtain analytical data directly from the laboratory and will perform a cursory review of the chemical data (EPA Level II validation) and QA/QC data prior to consulting with the Trust and agencies regarding the need to continue excavation or begin backfilling. The purpose of the cursory review is to identify any significant QC failures or elevated detection limits that would affect decisions regarding whether the data are sufficient to show that COCs are not present in confirmation soil samples at concentrations greater than cleanup levels. Preliminary analytical data will be screened against cleanup levels and cleanup level exceedances identified. Tables of preliminary data will be prepared and presented in weekly stakeholder meetings.

Level III and Level IV data validation will be performed after hard copies of comprehensive certificate of analysis (CCA; Level III) and the raw data packages (Level IV) are received from the laboratory. Validation will be performed and qualifiers will be applied to analytical results in accordance with the Presidio-Wide Quality Assurance Project Plan, U.S. Environmental Protection Agency Contract Laboratory Program National Functional Guidelines for Organic Data Review, and U.S. Environmental Protection Agency Contract Laboratory Program National Functional Guidelines for Inorganic Data Review. Raw data packages (Level IV) will be provided for at least 10 percent of the samples analyzed. The results of the Level III and Level IV data validation will be presented in the Construction Completion Report.

The backfill samples (to be used for backfilling excavations) will also be subject to similar data validation protocol to that for the confirmation samples.

Pertinent chain of custody information and analytical data (obtained electronically from the laboratory) will be loaded into MACTEC's database and the Presidio's database. Survey data (northing and easting coordinates) for the confirmation samples and data validation qualifiers will also be loaded into both databases. Database reports of Level III validated analytical data will be generated from MACTEC's database for presentation in the Construction Completion Report.

# I-7.0 REFERENCES

Department of Toxic Substances Control (DTSC), 2001. *Information Advisory for Clean Imported Fill Material*.

International Technology Corporation (IT), 1998. *Petroleum Tank Closure and Recommended Site Action Report, Presidio Fuel Tank Removal Program, Presidio of San Francisco, Volume 2, Appendices B & C.* November 1998.

MACTEC Engineering and Consulting, Inc. (MACTEC), 2006. *Corrective Action Plan, Building 207/231Area, Presidio of San Francisco, California*. September.

_____, 2007. *Final Corrective Action Plan, Building 207/231 Area, Presidio of San Francisco, California*.

TetraTech, 2001. *Presidio-Wide Quality Assurance Project Plan (QAPP), Sampling and Analysis Plan, Presidio of San Francisco, California*. April.

U.S. Environmental Protection Agency (EPA), 1994. *National Functional Guidelines for Inorganic Data Review*.

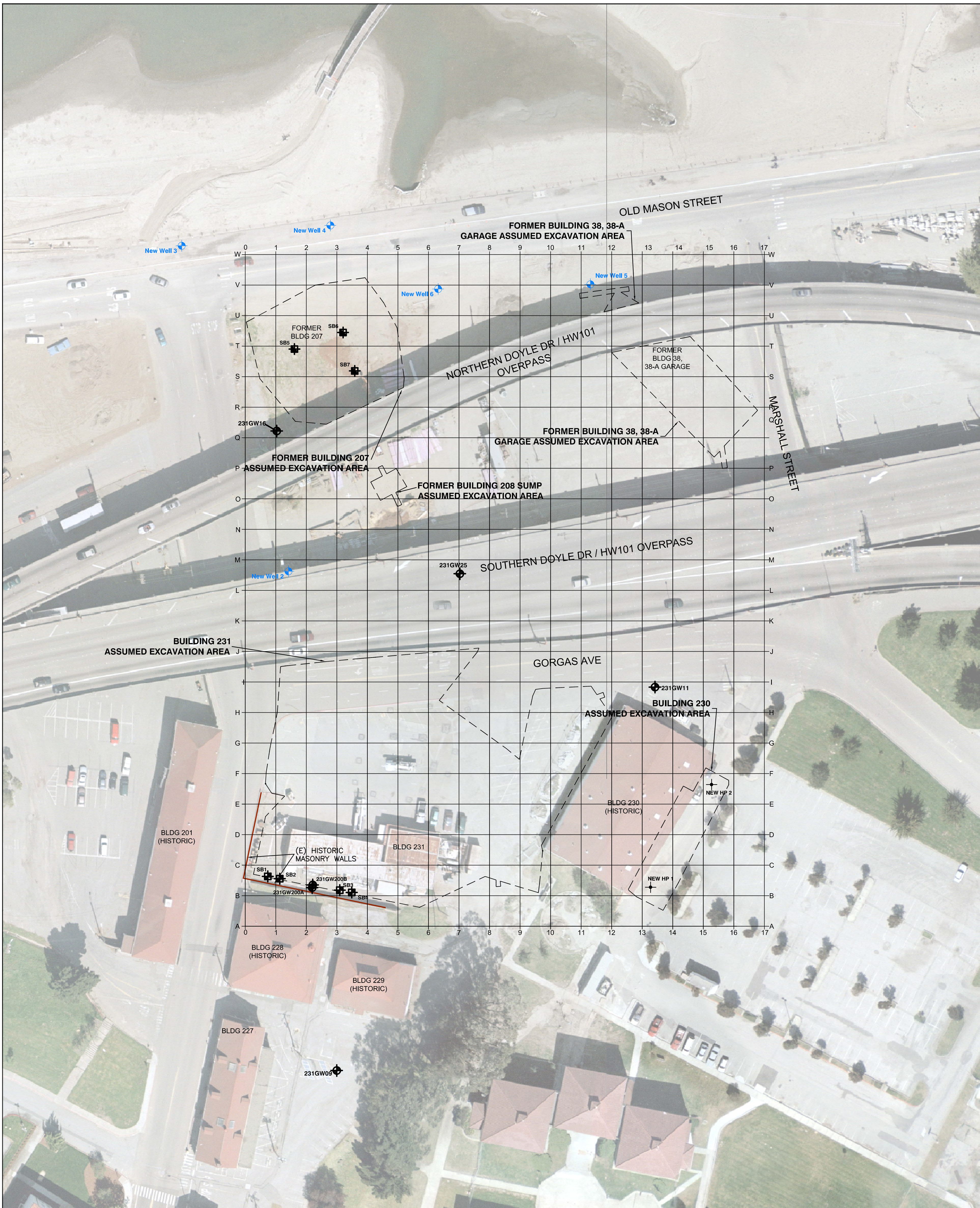
____, 1997. *Test Methods for Evaluating Solid Waste, Third Edition (Update III).* SW- 846.

____, 1999. *National Functional Guidelines for Organic Data Review*.

____, 2000. *Guidance for the Data Quality Objectives Process, Final*. QA/G-4, EPA/600/12-96/055.

APPENDIX I

FIGURE




LEGEND

| | |
|---|---|
| BUILDING 230 RU HYDROPUNCH SAMPLING LOCATIONS; SAMPLES TO BE COLLECTED PRIOR TO BACKFILLING DURING EXCAVATION ACTIVITIES. | NEW HP 1 |
| BUILDING 231 IN SITU REMEDIATION PORTION OF RU SOIL SAMPLING LOCATIONS; SAMPLES TO BE COLLECTED PRIOR TO CONDUCTING IN SITU INJECTION. | SB2 |
| BUILDING 207 RU SOIL SAMPLING LOCATIONS FOR LTTD TREATED BACKFILL | SB7 |
| EXISTING MONITORING WELL RETAINED | NEW WELL 4 |
| EXISTING MONITORING WELL RETAINED | 231GW09 |
| HISTORIC WALL | |
| ASSUMED EXCAVATION AREA | |
| PROPOSED SAMPLING GRID (SAMPLING GRID IS SPACED IN 25 FOOT INCREMENTS FOR ALL EXCAVATION AREAS) | B A 0 1 2 |

40 0 40 80
SCALE IN FEET

N

4084075106031.DWG 1.0
20081015.1536

MACTEC

**PROPOSED EXCAVATION CONFIRMATION SAMPLING GRID AND CORRECTIVE ACTION SAMPLING LOCATIONS**
**PRESIDIO BUILDING 207/231**
**PRESIDIO SAN FRANCISCO**
**SAN FRANCISCO, CALIFORNIA**

FIGURE: **I-1**

| DRAWN | JOB NUMBER | CHECKED | CHECKED DATE | APPROVED | APPROVED DATE |
|---|---|---|---|---|---|
| JHD | 4084075106 | JHD | 10/2008 | RR | 10/2008 |

APPENDIX J

DESIGN FOR SANITARY SEWER AND
PROPAGULE PLANTING AREA DRAINAGE

REVIEWED BY: RR

# CONTENTS



## TABLES



## FIGURES



## ATTACHMENTS

# J1.0 DESIGN FOR TEMPORARY SANITARY SEWER REROUTE

This memorandum presents the design basis, assumptions, and calculations performed to complete the design of the following features:

1. Temporary Sanitary Sewer Reroute Around the Project Site

2. Propagule Planting Area Drainage

## J1.1 Sewage Loading

Known Sewage Loading: 380 gallons per day (gpd) (0.3 gallons per minute [gpm]). See attached Table J-1.

Maximum Potential Sewage Loading (If all Buildings Occupied): 25,833 gpd (17.9 gpm).

## J1.2 Change in Elevation:

From Manhole to the southwest of Building 230 to Edie Road Trunk Line (Less than 10 feet).

## J1.3 Pump

Capable of 17 feet at 20 gpm to 15 feet at 40 gpm (see attached SKV-40), which is capable of providing the required head and flow rate (please see Attachment J1).

# J2.0 PROPAGULE PLANTING AREA DRAINAGE DESIGN

## J2.1 Existing Data Used to Conduct Design

### J2.1.1 Groundwater Levels, Shallow Zone Wells, Building 231 RU Area

1. Historical Groundwater Data from Shallow Wells (see Figure J-1 for locations of shallow zone wells).

2. Historic Groundwater Level Hydrographs for Shallow Zone Wells (Figure J-2 depicts data from May 2001 through May 2006).

3. Historic High Groundwater Level Data used to plot historic high groundwater potentiometric surface. The surface contours range from 11.6 feet to 9 feet NAVD 88 elevation (see Figure J-1).

4. Groundwater levels are at their highest elevation during March and May sampling events (see Figures J-2 through J-9).

### J2.1.2 Proposed Finish Surface Elevation

1. Proposed Finish Grade Elevations, except along the embankment slopes on the south, west, and east sides of Building 231 RU, range from 9 feet NAVD 88 to 11 feet NAVD 88 (see Figure J-1).

2. Typical finish grade elevations are 0.5 foot to 1 foot below historic high groundwater elevations (see Figure J-1).

3. Cost Differential is approximately $44,000 to raise the finish surface elevation to historic high elevation (see Attachment J2).

4. For majority of the year, except in spring and early summer, the finish surface elevations are above the groundwater elevations.

### J2.1.3 Tide Data

1. Tide Station in Crissy Field (www.noaa.gov) (see Figure J-10).

2. Tidal Fluctuations Relative to NAVD 88 (www.noaa.gov) (see Figure J-11).

#### J2.1.4 Precipitation Data

1. Rainfall characteristics used in the design include:

    - Intensity (rate of rainfall)

    - Duration (time rainfall lasts), and

    - Frequency (statistical probability of how often rainfall will occur).

Northern California's climate is characterized by long, dry summers and mild wet winters. Most of the annual precipitation occurs from November through March, with little or no rainfall from May through October. The rainfall intensity of the 100-yr, 6-hour storm was determined for the site location based on historical data from the nearest rain gage (0.41 inches per hour). The rainfall data were acquired from the National Oceanic and Atmospheric Administration website:

http://www.nws.noaa.gov/ohd/hdsc/noaaatlas2.htm.

The precipitation-frequency data output is presented as Attachment J3.

### J2.2 Volume of Surface Expression of Groundwater and Storm Water

Drainage to be provided to drain the surface water from the Building 231 RU area through the installed drain inlet and storm drain pipe into the existing 72-inch main storm drain line (see Figure J-1 for plan view and Figure 3-4 of the Work Plan for cross-sectional view).

The cross-sectional view shows the drain inlet elevation at the discharge end of the storm drain pipe and at the tie-in to the 72-inch main line to be approximately 6 feet relative to NAVD 88 datum. As such, with a factor of safety of 1.2, the elevation of the storm drain line at the connection point is 5 feet relative to NAVD 88 datum.

The tide elevations range from greater than 7 feet to less than -2 feet NAVD 88 elevation. During high tides, the water drains back into the 72-inch main storm drain line and toward the Site. The high tide elevation is higher than the elevation of the discharge end of the storm drain line installed on site.

From the attached tide chart, typically for 5 hours of the day, the tide elevation is higher than 5 feet relative to NAVD datum, which is the elevation of the storm drain pipe at the tie-in location. A check valve to be placed in the storm drain pipe to prevent tidal backflow into the Building 231 RU area.

### J2.2.1 Volume of Surface Water Collected During High Tide

1. Surface Expression of Storm Water:

   Quantity of Water = Precipitation Intensity (inches/hour) x (1 foot/12 inches) x (Drainage Area in square feet) x Period during which tide elevation exceeds 5 feet relative to NAVD 88 (see Attachment J4).

   <u>Volume of surface expression of storm water = 4,766 cubic feet.</u>

2. Groundwater Expression as Surface Water:

   Quantity of Water = (Drainage Area in square feet) x Difference between historic high groundwater elevation and finish surface (the upper end of the range, i.e., 1 foot is conservatively chosen for calculations) (see Attachment J4).

   <u>Volume of surface expression of ground water = 27,900 cubic feet.</u>

   Total Volume of Surface Water = 4,766 + 27,900 = 32,666 cubic feet

## J2.3 Design of Storm Drain Pipe Transferring Storm Water from Drain Inlet into the 72-Inch Main Line

1. Storm Drain Pipe Design

   - Plastic Pipe
   - 12-inch diameter
   - 0.5% slope
   - Flow Rate, Capacity = Manning's Velocity x Area of Pipe (see Reference 2 for Manning's coefficient for Plastic Pipe)
   - Flow Rate = 3.63 cubic feet per second (see Attachment J5).

2. Number of Hours Required to Drain the Drainage Area

   - Total Volume of Surface Water/ Flow Rate in Storm Drain Pipe = 2.7 hours

As the tide levels are below the bottom of the storm drain pipe discharge elevation of 5 feet NAVD 88 (with a factor of safety of 1.2) for 19 hours of the day; therefore, the design is appropriate.

## J2.4 Recommendations

The Building 231 RU will be backfilled to the final grades depicted on Figure J-1, and to minimize the surface expression of groundwater. Drainage will be provided through the installation of a drain inlet and a storm drain pipe that discharges groundwater that may rise above the final grade (in late winter and early spring based on historic groundwater elevation data) and storm water to an existing 72-inch storm drain that traverses through the Building 231 RU. However, prior to discharging groundwater to the storm drain, MACTEC will collect 1 groundwater sample (and 1 duplicate sample) from the excavation and test the sample for the RU-specific COCs. If COC concentrations are above the surface water criteria established for the Site, then the RU will be backfilled to historic high groundwater elevations in the area.

TABLES

TABLE J-1
Buildings and Anticipated Sewage Flow Rates in 207/231 Area

| Building Number | Square Footage (ft2)[1] | Occupied Status | Current Employee Count[2] | Current Sewage Flowrate (gpd)[3] | Anticipated Flow Rate (gpd)[4] |
|---|---|---|---|---|---|
| **Sewage from the South** | | | | | |
| 222 | 4,700 | Occupied | 15 | 300 | 940 |
| 223 | 4,800 | Not Available | Not Available | | 960 |
| 224 | 400 | Not Available | Not Available | | 80 |
| 225 | 900 | Not Available | Not Available | | 180 |
| 227 | 3,600 | Occupied | Not Available | | 720 |
| 228 | 12,076 | High Voltage Dept | Not Available | | 2415.2 |
| 229 | 2,758 | Vacant | Not Applicable | | 551.6 |
| 230 | 9,784 | Occupied | 4 | 80 | 1956.8 |
| **Sewage from the East** | | | | | |
| 1029 | 23,000 | Occupied | 1 Tenant (Employee?) | | 4600 |
| 1030 | 23,000 | Occupied | 1 Tenant (Employee?) | | 4600 |
| 1063 | 12,789 | Vacant | Not Applicable | | 2557.8 |
| 1062 | 12,869 | Occupied | 1 Tenant (0 Employee) | | 2573.8 |
| 1076 | 390 | Vacant | Not Applicable | | 78 |
| 1060 | 13,973 | Not Available | Not Available | | 2794.6 |
| 1061 | 100 | Not Available | Not Available | | 20 |
| 1059 | 3,403 | Not Available | Not Available | | 680.6 |
| 1056 | 625 | Not Available | Not Available | | 125 |
| | | Total Sewage Flow Rate (gpd) | | 380 | 25,833 |
| | | Total Sewage Flow Rate (gpm) | | 0.3 | 17.9 |

**Notes:**

1) Square footages provided by Signe Anderseel, CBRE, Email dated 8 August 2007 and/or estimated from CAD Drawings.

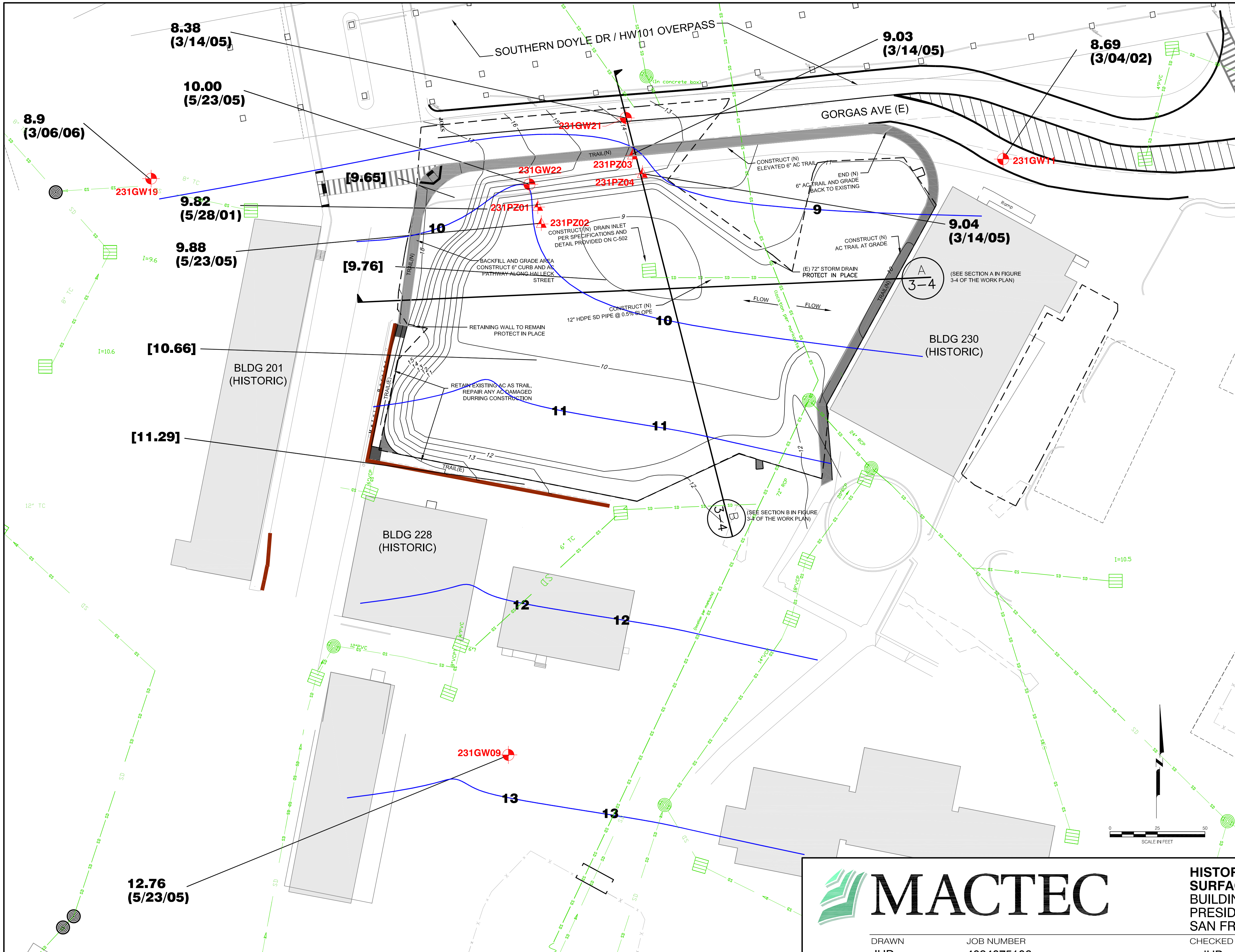
2) Employee counts provided by Signe Anderseel, CBRE, Email dated 8 August 2007.

3) Design Flow = 20 gallons per day/employee (USEPA, 2002 - Collection Systems Technology Fact Sheet, Sewers Convetional Gravity).

4) Design Flow = 0.20 gallons per day/net square feet (USEPA, 2002 - Collection Systems Technology Fact Sheet, Sewers Conventional Gravity).

Checked: RR
Approved: SS

FIGURES




## LEGEND:

| | |
|---|---|
| HISTORIC WALL | |
| (N) TOPOGRAPHIC CONTOUR | 24 |
| (E) TOPOGRAPHIC CONTOUR | 24 |
| NEW RAISED AC PATH | |
| RE-VEGETATION AREA | |
| MONITORING WELL - SHALLOW SAND | |
| PIEZOMETER - SHALLOW SAND | |
| INTERPOLATED SHALLOW ZONE GROUNDWATER ELEV. (NAVD 88) USED FOR CONTOUR GENERATION ONLY. | [11.67] |
| HISTORICAL HIGH SHALLOW ZONE GROUNDWATER ELEV. (NAVD 88) & DATE MONITORED (1) | 10.25 (5/23/05) |
| HIGH GROUNDWATER CONTOUR | 9 |

## NOTES

1. HIGHEST REPORTED GROUNDWATER ELEVATION DATA FROM 2001 THROUGH 2006 FOUND IN THE PRESIDIO SEMI ANNUAL GROUNDWATER MONITORING REPORT 1ST AND 2ND QUARTERS 2006 (TREADWELL AND ROLLO, OCTOBER 2006)

2. ALL WATER LEVELS ARE SHOWN IN NAVD 88-US SURVEY FEET, THEY HAVE BEEN CONVERTED FROM PLLW TO BE CONSISTENT WITH TOPOGRAPHIC SURVEY DATA.
CONVERSION: NAVD 88 = PLLW-0.37

MACTEC

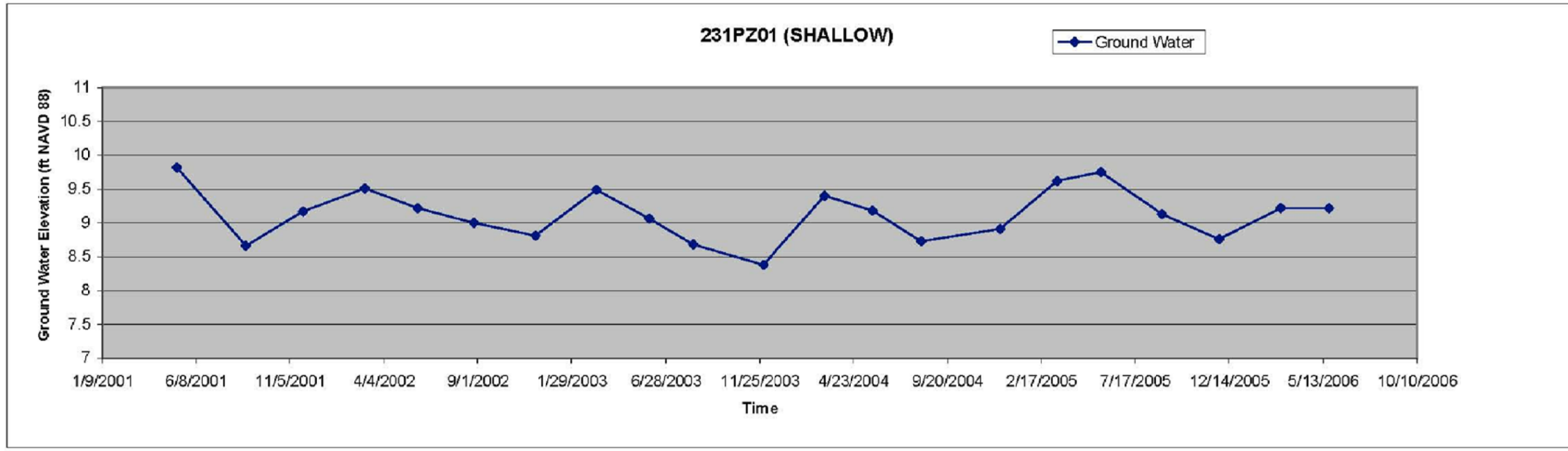
HISTORIC HIGH SHALLOW GROUNDWATER
SURFACE AND BUILDING 231 RU RESTORATION PLAN
BUILDING 207/231 AREA
PRESIDIO OF SAN FRANCISCO
SAN FRANCISCO, CALIFORNIA

FIGURE
J-1

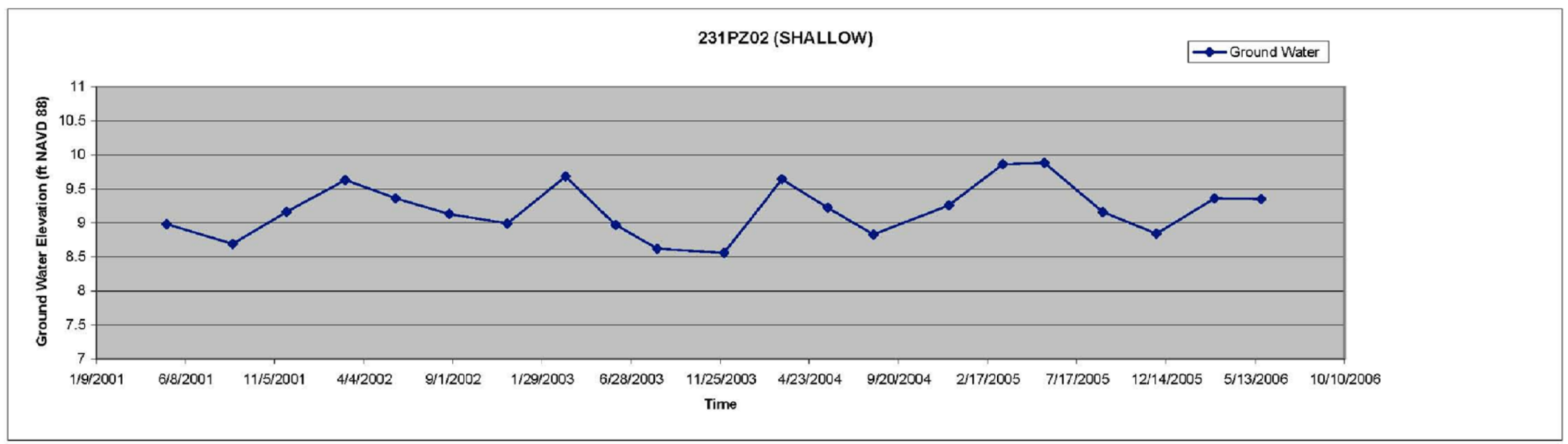
| DRAWN | JOB NUMBER | CHECKED | CHCK'D DATE | APPROVED | APPRV'D DATE |
|---|---|---|---|---|---|
| JHD | 4084075106 | JHD | 10/2008 | RR | 10/2008 |

4084075106073.DWG 40.0
20081015.1714

| 231PZ01 | | |
|---|---|---|
| DATE | GW Elev. (feet PLLW) | GW Elev. (feet NAVD 88) |
| 5/22/2006 | 9.59 | 9.22 |
| 3/6/2006 | 9.59 | 9.22 |
| 11/28/2005 | 9.13 | 8.76 |
| 8/29/2005 | 9.5 | 9.13 |
| 5/23/2005 | 10.12 | 9.75 |
| 3/14/2005 | 9.99 | 9.62 |
| 12/13/2004 | 9.28 | 8.91 |
| 8/9/2004 | 9.1 | 8.73 |
| 5/24/2004 | 9.55 | 9.18 |
| 3/8/2004 | 9.77 | 9.4 |
| 12/1/2003 | 8.75 | 8.38 |
| 8/11/2003 | 9.05 | 8.68 |
| 6/2/2003 | 9.43 | 9.06 |
| 3/10/2003 | 9.86 | 9.49 |
| 12/2/2002 | 9.18 | 8.81 |
| 8/26/2002 | 9.37 | 9 |
| 5/28/2002 | 9.59 | 9.22 |
| 3/4/2002 | 9.88 | 9.51 |
| 11/26/2001 | 9.54 | 9.17 |
| 8/27/2001 | 9.03 | 8.66 |
| 5/8/2001 | 10.19 | 9.82 |




| 231PZ02 | | |
|---|---|---|
| DATE | GW Elev. (feet PLLW) | GW Elev. (feet NAVD 88) |
| 5/22/2006 | 9.72 | 9.35 |
| 3/6/2006 | 9.73 | 9.36 |
| 11/28/2005 | 9.21 | 8.84 |
| 8/29/2005 | 9.53 | 9.16 |
| 5/23/2005 | 10.25 | 9.88 |
| 3/14/2005 | 10.23 | 9.86 |
| 12/13/2004 | 9.63 | 9.26 |
| 8/9/2004 | 9.2 | 8.83 |
| 5/24/2004 | 9.59 | 9.22 |
| 3/8/2004 | 10.01 | 9.64 |
| 12/1/2003 | 8.93 | 8.56 |
| 8/11/2003 | 8.99 | 8.62 |
| 6/2/2003 | 9.34 | 8.97 |
| 3/10/2003 | 10.05 | 9.68 |
| 12/2/2002 | 9.36 | 8.99 |
| 8/26/2002 | 9.5 | 9.13 |
| 5/28/2002 | 9.73 | 9.36 |
| 3/4/2002 | 10 | 9.63 |
| 11/26/2001 | 9.53 | 9.16 |
| 8/27/2001 | 9.06 | 8.69 |
| 5/8/2001 | 9.35 | 8.98 |




## NOTES

1. REPORTED GROUNDWATER ELEVATION DATA FROM 2001 THROUGH 2006 FOUND IN THE PRESIDIO SEMI ANNUAL GROUNDWATER MONITORING REPORT 1ST AND 2ND QUARTERS 2006 (TREADWELL AND ROLLO, OCTOBER 2006)

2. ALL WATER LEVELS SHOWN IN NAVD 88- US SURVEY FEET, HAVE BEEN CONVERTED FROM PLLW TO BE CONSISTENT WITH TOPOGRAPHIC SURVEY DATA. CONVERSION: NAVD 88 = PLLW-0.37

3. THE DATE AND ASSOCIATED WATER LEVELS HIGHLIGHTED IN GREEN ARE THE LOW VALUES; DATE AND ASSOCIATED WATER LEVELS HIGHLIGHTED IN YELLOW ARE THE HIGH VALUES.

MACTEC

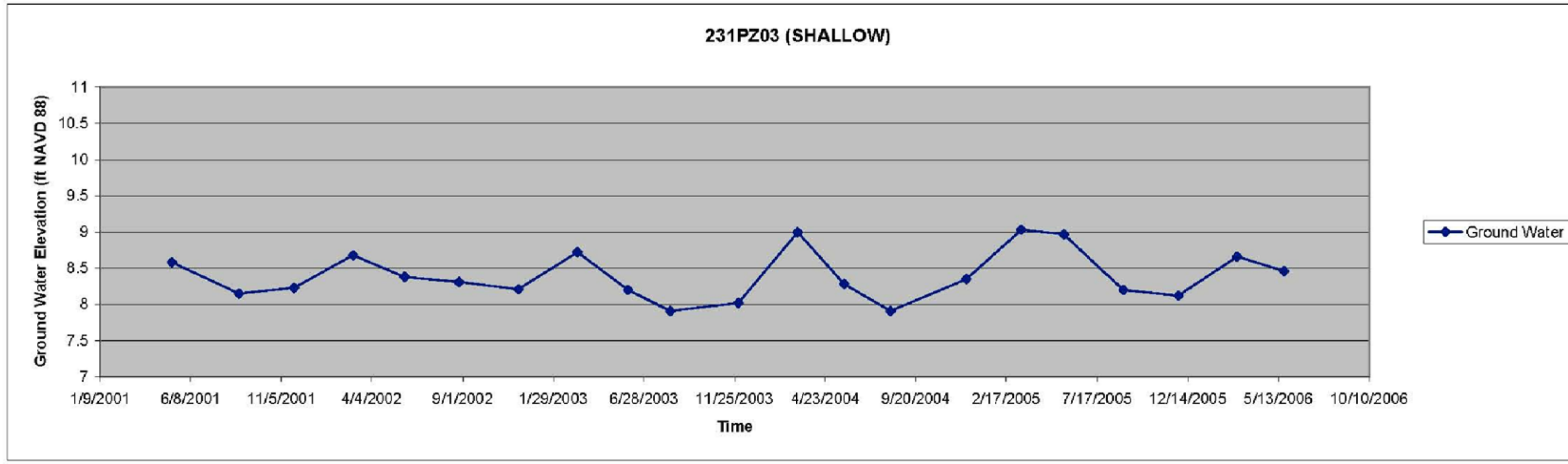
**HISTORICAL WATER LEVEL HYDROGRAPHS FOR SHALLOW ZONE AQUIFER WELLS: 231PZ01 / 231PZ02**
BUILDING 207/231 AREA
PRESIDIO OF SAN FRANCISCO
SAN FRANCISCO, CALIFORNIA

FIGURE
**J-2**

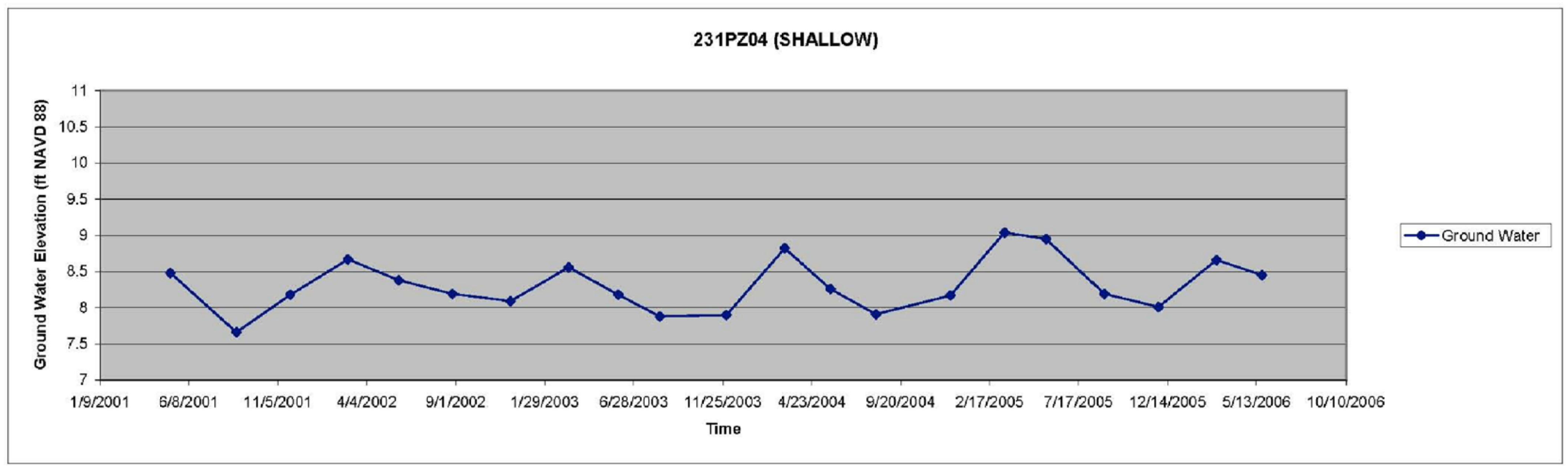
| DRAWN | JOB NUMBER | CHECKED | CHCK'D DATE | APPROVED | APPRV'D DATE |
|---|---|---|---|---|---|
| JHD | 4084075106 | JHD | 10/2008 | RR | 10/2008 |

4084075106073.DWG 40.0
20071019.1648

| 231PZ03 | | |
|---|---|---|
| DATE | GW Elev. (feet PLLW) | GW Elev. (feet NAVD 88) |
| 5/22/2006 | 8.83 | 8.46 |
| 3/6/2006 | 9.03 | 8.66 |
| 11/28/2005 | 8.49 | 8.12 |
| 8/29/2005 | 8.57 | 8.2 |
| 5/23/2005 | 9.34 | 8.97 |
| 3/14/2005 | 9.4 | 9.03 |
| 12/13/2004 | 8.72 | 8.35 |
| 8/9/2004 | 8.28 | 7.91 |
| 5/24/2004 | 8.65 | 8.28 |
| 3/8/2004 | 9.37 | 9 |
| 12/1/2003 | 8.39 | 8.02 |
| 8/11/2003 | 8.28 | 7.91 |
| 6/2/2003 | 8.57 | 8.2 |
| 3/10/2003 | 9.09 | 8.72 |
| 12/2/2002 | 8.58 | 8.21 |
| 8/26/2002 | 8.68 | 8.31 |
| 5/28/2002 | 8.75 | 8.38 |
| 3/4/2002 | 9.05 | 8.68 |
| 11/26/2001 | 8.6 | 8.23 |
| 8/27/2001 | 8.52 | 8.15 |
| 5/8/2001 | 8.95 | 8.58 |




| 231PZ04 | | |
|---|---|---|
| DATE | GW Elev. (feet PLLW) | GW Elev. (feet NAVD 88) |
| 5/22/2006 | 8.82 | 8.45 |
| 3/6/2006 | 9.03 | 8.66 |
| 11/28/2005 | 8.38 | 8.01 |
| 8/29/2005 | 8.56 | 8.19 |
| 5/23/2005 | 9.32 | 8.95 |
| 3/14/2005 | 9.41 | 9.04 |
| 12/13/2004 | 8.54 | 8.17 |
| 8/9/2004 | 8.28 | 7.91 |
| 5/24/2004 | 8.63 | 8.26 |
| 3/8/2004 | 9.19 | 8.82 |
| 12/1/2003 | 8.27 | 7.9 |
| 8/11/2003 | 8.25 | 7.88 |
| 6/2/2003 | 8.55 | 8.18 |
| 3/10/2003 | 8.93 | 8.56 |
| 12/2/2002 | 8.46 | 8.09 |
| 8/26/2002 | 8.56 | 8.19 |
| 5/28/2002 | 8.75 | 8.38 |
| 3/4/2002 | 9.04 | 8.67 |
| 11/26/2001 | 8.55 | 8.18 |
| 8/27/2001 | 8.03 | 7.66 |
| 5/8/2001 | 8.85 | 8.48 |




**NOTES**

1. REPORTED GROUNDWATER ELEVATION DATA FROM 2001 THROUGH 2006 FOUND IN THE PRESIDIO SEMI ANNUAL GROUNDWATER MONITORING REPORT 1ST AND 2ND QUARTERS 2006 (TREADWELL AND ROLLO, OCTOBER 2006)

2. ALL WATER LEVELS SHOWN IN NAVD 88- US SURVEY FEET, HAVE BEEN CONVERTED FROM PLLW TO BE CONSISTENT WITH TOPOGRAPHIC SURVEY DATA. CONVERSION: NAVD 88 = PLLW-0.37

3. THE DATE AND ASSOCIATED WATER LEVELS HIGHLIGHTED IN GREEN ARE THE LOW VALUES; DATE AND ASSOCIATED WATER LEVELS HIGHLIGHTED IN YELLOW ARE THE HIGH VALUES.

MACTEC

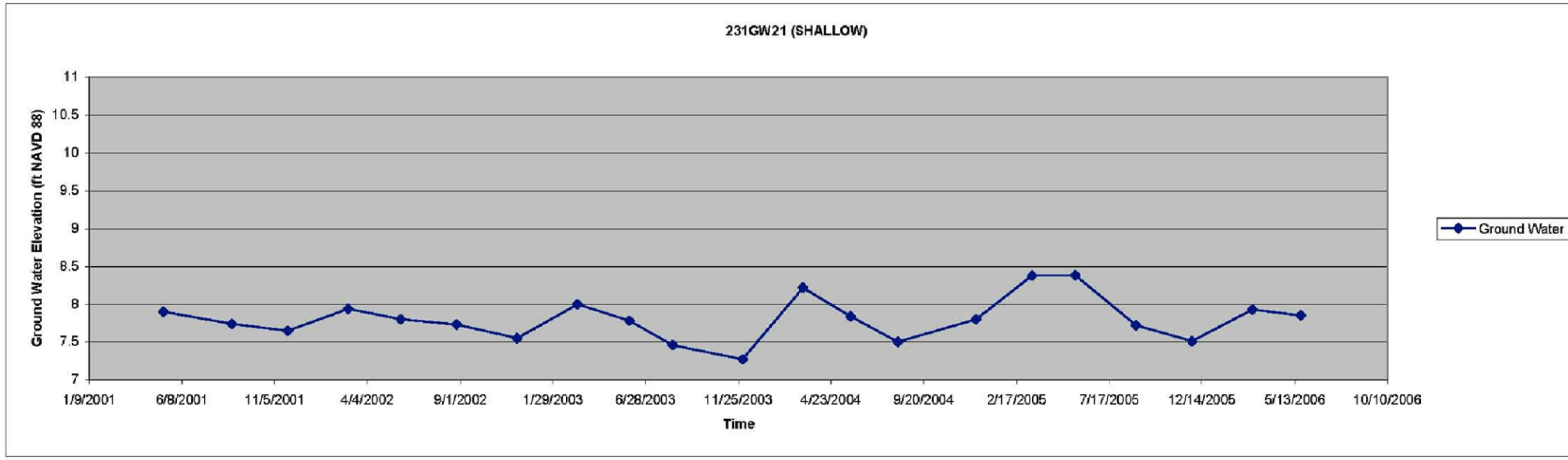
**HISTORICAL WATER LEVEL HYDROGRAPHS FOR SHALLOW ZONE AQUIFER WELLS: 231PZ03 / 231PZ04**
BUILDING 207/231 AREA
PRESIDIO OF SAN FRANCISCO
SAN FRANCISCO, CALIFORNIA

FIGURE
**J-3**

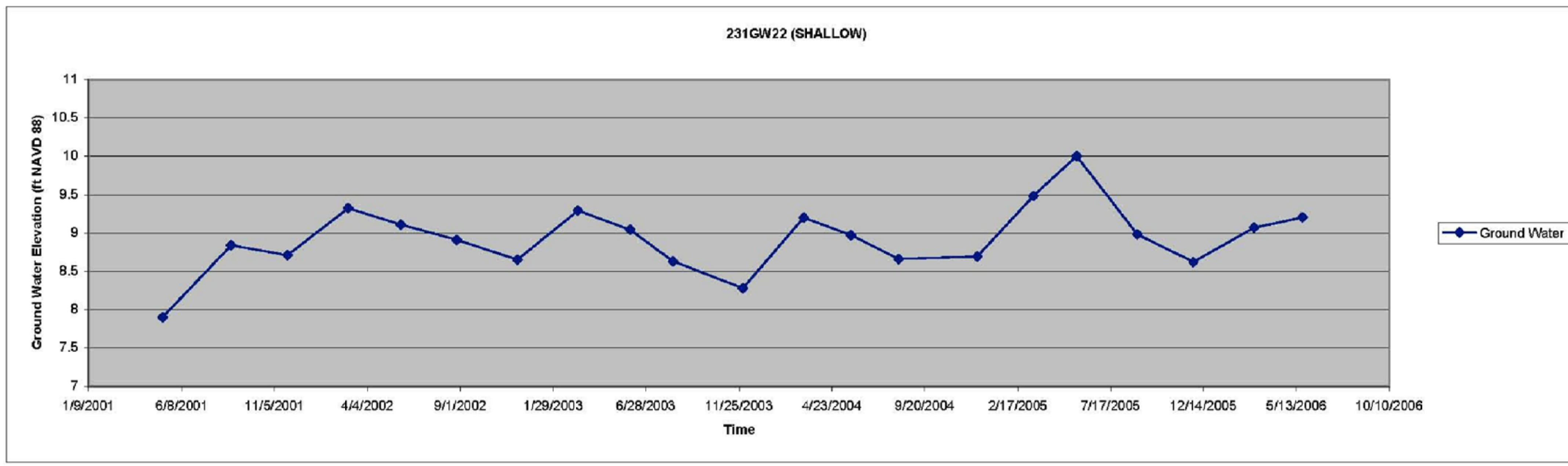
| DRAWN | JOB NUMBER | CHECKED | CHCK'D DATE | APPROVED | APPRV'D DATE |
|---|---|---|---|---|---|
| JHD | 4084075106 | JHD | 10/2008 | RR | 10/2008 |

4084075106073.DWG 40.0
20071019.1648

| 231GW21 | | |
|---|---|---|
| DATE | GW Elev. (feet PLLW) | GW Elev. (feet NAVD 88) |
| 5/22/2006 | 8.22 | 7.85 |
| 3/6/2006 | 8.3 | 7.93 |
| 11/28/2005 | 7.88 | 7.51 |
| 8/29/2005 | 8.09 | 7.72 |
| 5/23/2005 | 8.75 | 8.38 |
| 3/14/2005 | 8.75 | 8.38 |
| 12/13/2004 | 8.17 | 7.8 |
| 8/9/2004 | 7.87 | 7.5 |
| 5/24/2004 | 8.21 | 7.84 |
| 3/8/2004 | 8.59 | 8.22 |
| 12/1/2003 | 7.64 | 7.27 |
| 8/11/2003 | 7.83 | 7.46 |
| 6/2/2003 | 8.15 | 7.78 |
| 3/10/2003 | 8.37 | 8 |
| 12/2/2002 | 7.92 | 7.55 |
| 8/26/2002 | 8.1 | 7.73 |
| 5/28/2002 | 8.17 | 7.8 |
| 3/4/2002 | 8.31 | 7.94 |
| 11/26/2001 | 8.02 | 7.65 |
| 8/27/2001 | 8.11 | 7.74 |
| 5/8/2001 | 8.27 | 7.9 |




| 231GW22 | | |
|---|---|---|
| DATE | GW Elev. (feet PLLW) | GW Elev. (feet NAVD 88) |
| 5/22/2006 | 9.57 | 9.2 |
| 3/6/2006 | 9.44 | 9.07 |
| 11/28/2005 | 8.99 | 8.62 |
| 8/29/2005 | 9.35 | 8.98 |
| 5/23/2005 | 10.37 | 10 |
| 3/14/2005 | 9.85 | 9.48 |
| 12/13/2004 | 9.06 | 8.69 |
| 8/9/2004 | 9.03 | 8.66 |
| 5/24/2004 | 9.34 | 8.97 |
| 3/8/2004 | 9.57 | 9.2 |
| 12/1/2003 | 8.65 | 8.28 |
| 8/11/2003 | 9 | 8.63 |
| 6/2/2003 | 9.41 | 9.04 |
| 3/10/2003 | 9.66 | 9.29 |
| 12/2/2002 | 9.02 | 8.65 |
| 8/26/2002 | 9.28 | 8.91 |
| 5/28/2002 | 9.48 | 9.11 |
| 3/4/2002 | 9.69 | 9.32 |
| 11/26/2001 | 9.08 | 8.71 |
| 8/27/2001 | 9.21 | 8.84 |
| 5/8/2001 | 8.27 | 7.9 |




**NOTES**

1. REPORTED GROUNDWATER ELEVATION DATA FROM 2001 THROUGH 2006 FOUND IN THE PRESIDIO SEMI ANNUAL GROUNDWATER MONITORING REPORT 1ST AND 2ND QUARTERS 2006 (TREADWELL AND ROLLO, OCTOBER 2006)

2. ALL WATER LEVELS SHOWN IN NAVD 88- US SURVEY FEET, HAVE BEEN CONVERTED FROM PLLW TO BE CONSISTENT WITH TOPOGRAPHIC SURVEY DATA. CONVERSION: NAVD 88 = PLLW-0.37

3. THE DATE AND ASSOCIATED WATER LEVELS HIGHLIGHTED IN GREEN ARE THE LOW VALUES; DATE AND ASSOCIATED WATER LEVELS HIGHLIGHTED IN YELLOW ARE THE HIGH VALUES.

MACTEC

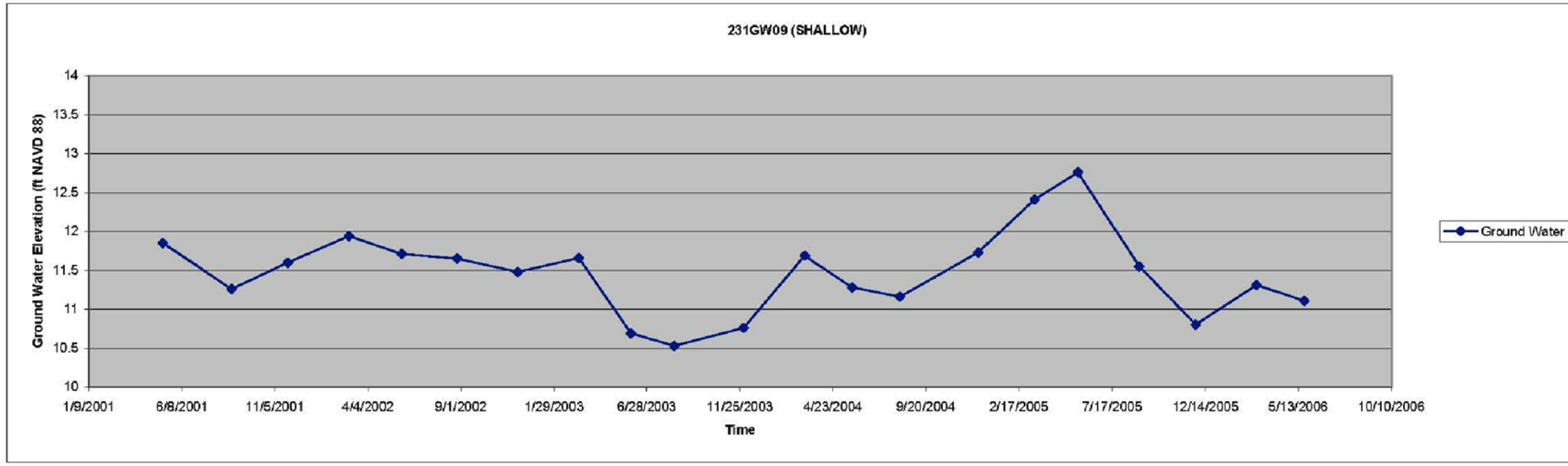
**HISTORICAL WATER LEVEL HYDROGRAPHS FOR SHALLOW ZONE AQUIFER WELLS: 231GW21 / 231GW22**
BUILDING 207/231 AREA
PRESIDIO OF SAN FRANCISCO
SAN FRANCISCO, CALIFORNIA

FIGURE
**J-4**

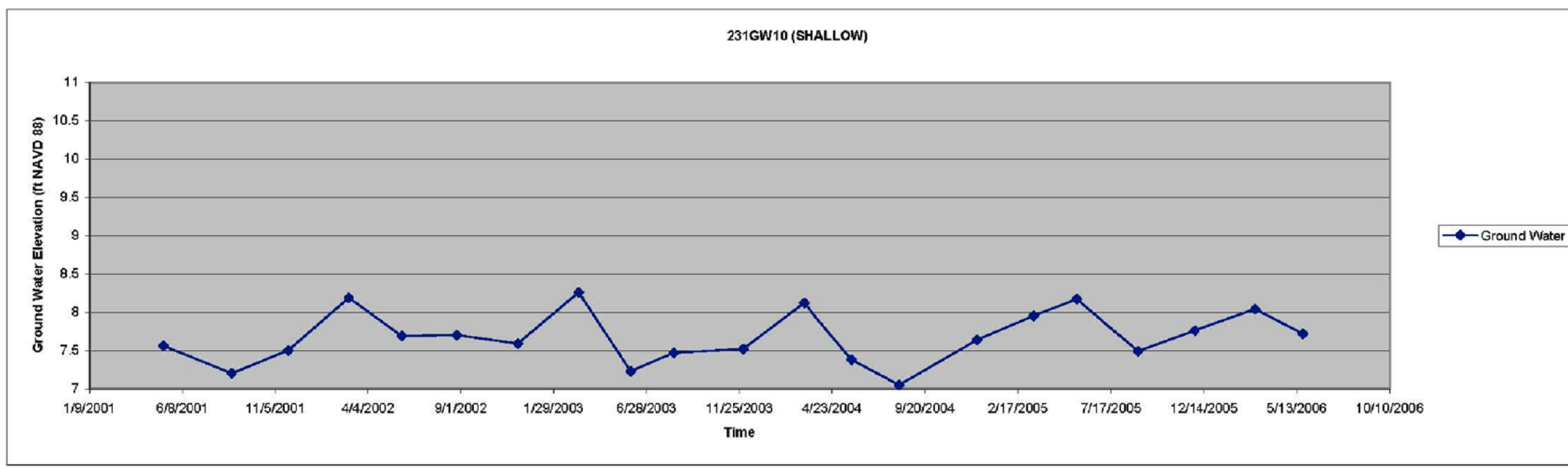
| DRAWN | JOB NUMBER | CHECKED | CHCK'D DATE | APPROVED | APPRV'D DATE |
|---|---|---|---|---|---|
| JHD | 4084075106 | JHD | 10/2008 | RR | 10/2008 |

4084075106073.DWG 40.0
20071019.1648

| 231GW09 | | |
|---|---|---|
| DATE | GW Elev. (feet PLLW) | GW Elev. (feet NAVD 88) |
| 5/22/2006 | 11.48 | 11.11 |
| 3/6/2006 | 11.68 | 11.31 |
| 11/28/2005 | 11.17 | 10.8 |
| 8/29/2005 | 11.92 | 11.55 |
| 5/23/2005 | 13.13 | 12.76 |
| 3/14/2005 | 12.78 | 12.41 |
| 12/13/2004 | 12.1 | 11.73 |
| 8/9/2004 | 11.53 | 11.16 |
| 5/24/2004 | 11.65 | 11.28 |
| 3/8/2004 | 12.06 | 11.69 |
| 12/1/2003 | 11.13 | 10.76 |
| 8/11/2003 | 10.9 | 10.53 |
| 6/2/2003 | 11.06 | 10.69 |
| 3/10/2003 | 12.03 | 11.66 |
| 12/2/2002 | 11.85 | 11.48 |
| 8/26/2002 | 12.02 | 11.65 |
| 5/28/2002 | 12.08 | 11.71 |
| 3/4/2002 | 12.31 | 11.94 |
| 11/26/2001 | 11.97 | 11.6 |
| 8/27/2001 | 11.63 | 11.26 |
| 5/8/2001 | 12.22 | 11.85 |




| 231GW10 | | |
|---|---|---|
| DATE | GW Elev. (feet PLLW) | GW Elev. (feet NAVD 88) |
| 5/22/2006 | 8.09 | 7.72 |
| 3/6/2006 | 8.41 | 8.04 |
| 11/28/2005 | 8.13 | 7.76 |
| 8/29/2005 | 7.86 | 7.49 |
| 5/23/2005 | 8.54 | 8.17 |
| 3/14/2005 | 8.32 | 7.95 |
| 12/13/2004 | 8.01 | 7.64 |
| 8/9/2004 | 7.42 | 7.05 |
| 5/24/2004 | 7.75 | 7.38 |
| 3/8/2004 | 8.49 | 8.12 |
| 12/1/2003 | 7.89 | 7.52 |
| 8/11/2003 | 7.84 | 7.47 |
| 6/2/2003 | 7.6 | 7.23 |
| 3/10/2003 | 8.63 | 8.26 |
| 12/2/2002 | 7.96 | 7.59 |
| 8/26/2002 | 8.07 | 7.7 |
| 5/28/2002 | 8.06 | 7.69 |
| 3/4/2002 | 8.56 | 8.19 |
| 11/26/2001 | 7.87 | 7.5 |
| 8/27/2001 | 7.57 | 7.2 |
| 5/8/2001 | 7.93 | 7.56 |




## NOTES

1. REPORTED GROUNDWATER ELEVATION DATA FROM 2001 THROUGH 2006 FOUND IN THE PRESIDIO SEMI ANNUAL GROUNDWATER MONITORING REPORT 1ST AND 2ND QUARTERS 2006 (TREADWELL AND ROLLO, OCTOBER 2006)

2. ALL WATER LEVELS SHOWN IN NAVD 88- US SURVEY FEET, HAVE BEEN CONVERTED FROM PLLW TO BE CONSISTENT WITH TOPOGRAPHIC SURVEY DATA. CONVERSION: NAVD 88 = PLLW-0.37

3. THE DATE AND ASSOCIATED WATER LEVELS HIGHLIGHTED IN GREEN ARE THE LOW VALUES; DATE AND ASSOCIATED WATER LEVELS HIGHLIGHTED IN YELLOW ARE THE HIGH VALUES.

40840/5106073.DWG 40.0
20071019.1648

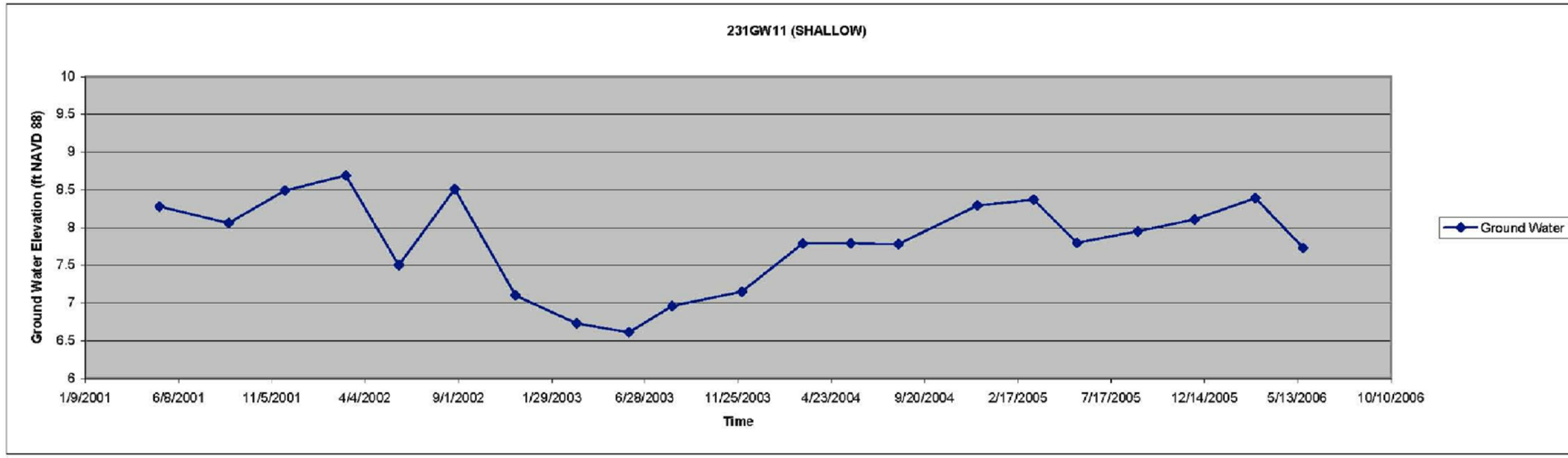
MACTEC

**HISTORICAL WATER LEVEL HYDROGRAPHS FOR SHALLOW ZONE AQUIFER WELLS: 231GW09 / 231GW10**
BUILDING 207/231 AREA
PRESIDIO OF SAN FRANCISCO
SAN FRANCISCO, CALIFORNIA

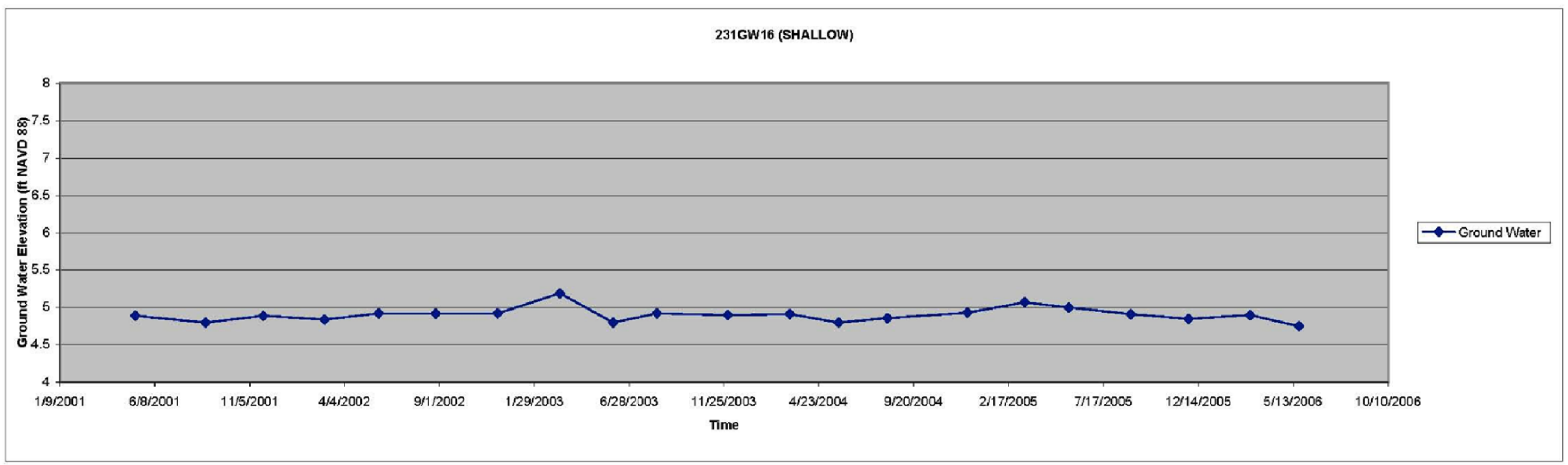
FIGURE
**J-5**

| DRAWN | JOB NUMBER | CHECKED | CHCK'D DATE | APPROVED | APPRV'D DATE |
|---|---|---|---|---|---|
| JHD | 4084075106 | JHD | 10/2008 | RR | 10/2008 |

| 231GW11 | | |
|---|---|---|
| DATE | GW Elev. (feet PLLW) | GW Elev. (feet NAVD 88) |
| 5/22/2006 | 8.1 | 7.73 |
| 3/6/2006 | 8.76 | 8.39 |
| 11/28/2005 | 8.48 | 8.11 |
| 8/29/2005 | 8.32 | 7.95 |
| 5/23/2005 | 8.17 | 7.8 |
| 3/14/2005 | 8.74 | 8.37 |
| 12/13/2004 | 8.66 | 8.29 |
| 8/9/2004 | 8.15 | 7.78 |
| 5/24/2004 | 8.16 | 7.79 |
| 3/8/2004 | 8.16 | 7.79 |
| 12/1/2003 | 7.52 | 7.15 |
| 8/11/2003 | 7.33 | 6.96 |
| 6/2/2003 | 6.98 | 6.61 |
| 3/10/2003 | 7.1 | 6.73 |
| 12/2/2002 | 7.47 | 7.1 |
| 8/26/2002 | 8.88 | 8.51 |
| 5/28/2002 | 7.87 | 7.5 |
| 3/4/2002 | 9.06 | 8.69 |
| 11/26/2001 | 8.86 | 8.49 |
| 8/27/2001 | 8.43 | 8.06 |
| 5/8/2001 | 8.65 | 8.28 |




| 231GW16 | | |
|---|---|---|
| DATE | GW Elev. (feet PLLW) | GW Elev. (feet NAVD 88) |
| 5/22/2006 | 5.12 | 4.75 |
| 3/6/2006 | 5.27 | 4.9 |
| 11/28/2005 | 5.22 | 4.85 |
| 8/29/2005 | 5.28 | 4.91 |
| 5/23/2005 | 5.37 | 5 |
| 3/14/2005 | 5.44 | 5.07 |
| 12/13/2004 | 5.3 | 4.93 |
| 8/9/2004 | 5.23 | 4.86 |
| 5/24/2004 | 5.17 | 4.8 |
| 3/8/2004 | 5.28 | 4.91 |
| 12/1/2003 | 5.27 | 4.9 |
| 8/11/2003 | 5.29 | 4.92 |
| 6/2/2003 | 5.17 | 4.8 |
| 3/10/2003 | 5.56 | 5.19 |
| 12/2/2002 | 5.29 | 4.92 |
| 8/26/2002 | 5.29 | 4.92 |
| 5/28/2002 | 5.29 | 4.92 |
| 3/4/2002 | 5.21 | 4.84 |
| 11/26/2001 | 5.26 | 4.89 |
| 8/27/2001 | 5.17 | 4.8 |
| 5/8/2001 | 5.26 | 4.89 |




## NOTES

1. REPORTED GROUNDWATER ELEVATION DATA FROM 2001 THROUGH 2006 FOUND IN THE PRESIDIO SEMI ANNUAL GROUNDWATER MONITORING REPORT 1ST AND 2ND QUARTERS 2006 (TREADWELL AND ROLLO, OCTOBER 2006)

2. ALL WATER LEVELS SHOWN IN NAVD 88- US SURVEY FEET, HAVE BEEN CONVERTED FROM PLLW TO BE CONSISTENT WITH TOPOGRAPHIC SURVEY DATA. CONVERSION: NAVD 88 = PLLW-0.37

3. THE DATE AND ASSOCIATED WATER LEVELS HIGHLIGHTED IN GREEN ARE THE LOW VALUES; DATE AND ASSOCIATED WATER LEVELS HIGHLIGHTED IN YELLOW ARE THE HIGH VALUES.

MACTEC

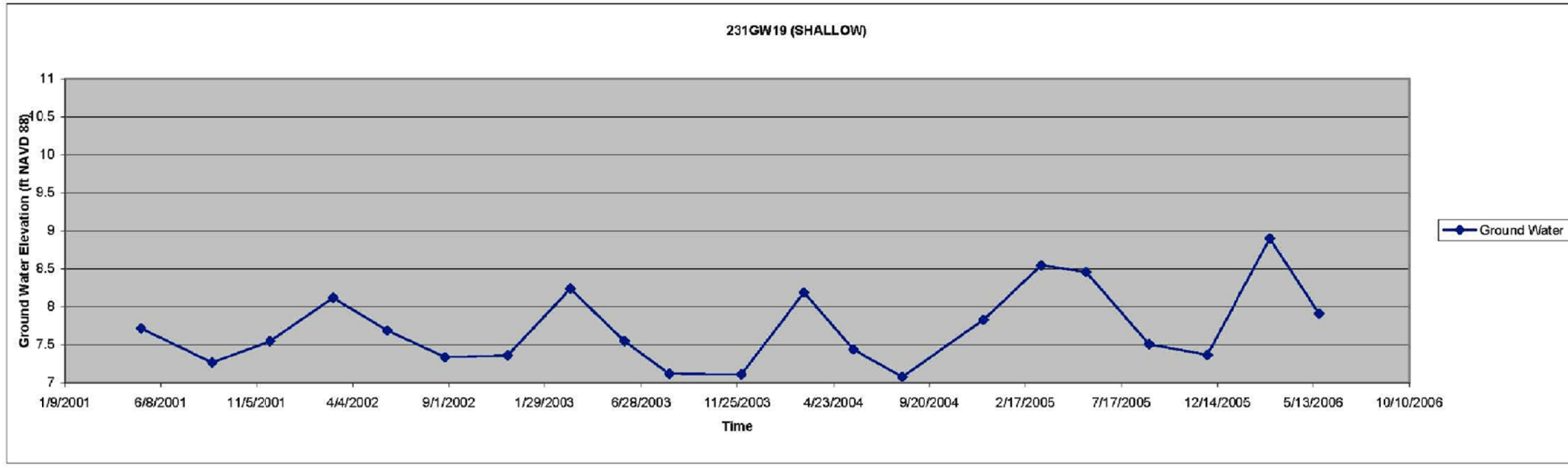
**HISTORICAL WATER LEVEL HYDROGRAPHS FOR SHALLOW ZONE AQUIFER WELLS: 231GW11 / 231GW16**
BUILDING 207/231 AREA
PRESIDIO OF SAN FRANCISCO
SAN FRANCISCO, CALIFORNIA

FIGURE **J-6**

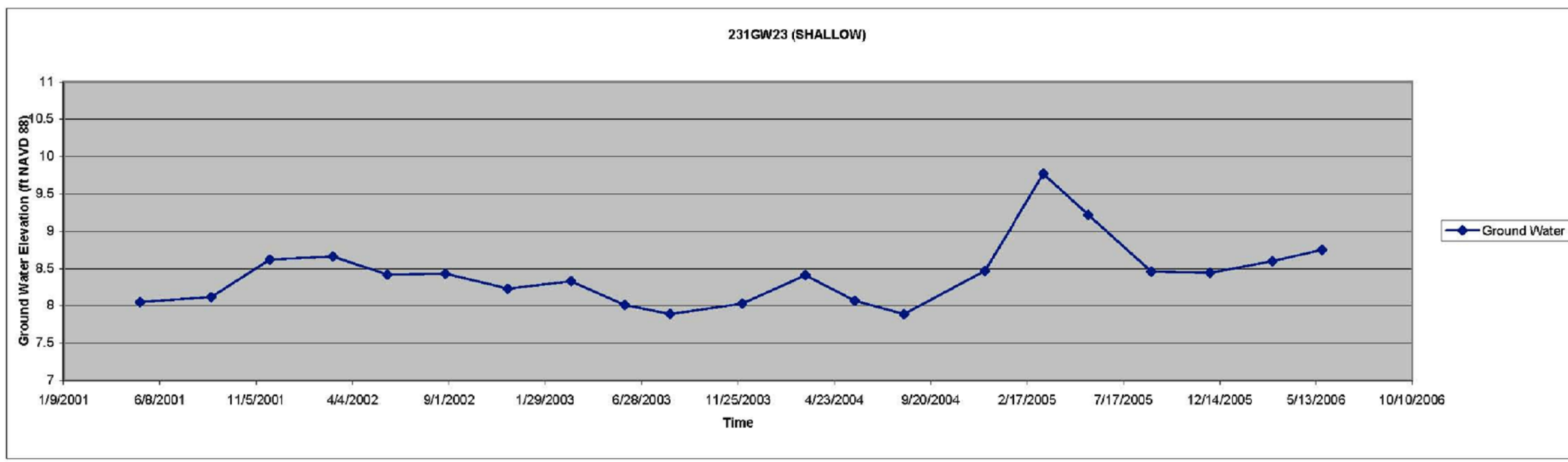
| DRAWN | JOB NUMBER | CHECKED | CHCK'D DATE | APPROVED | APPRV'D DATE |
|---|---|---|---|---|---|
| JHD | 4084075106 | JHD | 10/2008 | RR | 10/2008 |

4084075106073.DWG 40.0
20071019.1648

| 231GW19 | | |
|---|---|---|
| DATE | GW Elev. (feet PLLW) | GW Elev. (feet NAVD 88) |
| 5/22/2006 | 8.28 | 7.91 |
| 3/6/2006 | 9.27 | 8.9 |
| 11/28/2005 | 7.74 | 7.37 |
| 8/29/2005 | 7.88 | 7.51 |
| 5/23/2005 | 8.83 | 8.46 |
| 3/14/2005 | 8.92 | 8.55 |
| 12/13/2004 | 8.2 | 7.83 |
| 8/9/2004 | 7.45 | 7.08 |
| 5/24/2004 | 7.81 | 7.44 |
| 3/8/2004 | 8.56 | 8.19 |
| 12/1/2003 | 7.48 | 7.11 |
| 8/11/2003 | 7.49 | 7.12 |
| 6/2/2003 | 7.92 | 7.55 |
| 3/10/2003 | 8.61 | 8.24 |
| 12/2/2002 | 7.73 | 7.36 |
| 8/26/2002 | 7.71 | 7.34 |
| 5/28/2002 | 8.06 | 7.69 |
| 3/4/2002 | 8.49 | 8.12 |
| 11/26/2001 | 7.92 | 7.55 |
| 8/27/2001 | 7.64 | 7.27 |
| 5/8/2001 | 8.09 | 7.72 |




| 231GW23 | | |
|---|---|---|
| DATE | GW Elev. (feet PLLW) | GW Elev. (feet NAVD 88) |
| 5/22/2006 | 9.12 | 8.75 |
| 3/6/2006 | 8.97 | 8.6 |
| 11/28/2005 | 8.81 | 8.44 |
| 8/29/2005 | 8.83 | 8.46 |
| 5/23/2005 | 9.59 | 9.22 |
| 3/14/2005 | 10.14 | 9.77 |
| 12/13/2004 | 8.84 | 8.47 |
| 8/9/2004 | 8.26 | 7.89 |
| 5/24/2004 | 8.44 | 8.07 |
| 3/8/2004 | 8.78 | 8.41 |
| 12/1/2003 | 8.4 | 8.03 |
| 8/11/2003 | 8.26 | 7.89 |
| 6/2/2003 | 8.38 | 8.01 |
| 3/10/2003 | 8.7 | 8.33 |
| 12/2/2002 | 8.6 | 8.23 |
| 8/26/2002 | 8.8 | 8.43 |
| 5/28/2002 | 8.79 | 8.42 |
| 3/4/2002 | 9.03 | 8.66 |
| 11/26/2001 | 8.99 | 8.62 |
| 8/27/2001 | 8.49 | 8.12 |
| 5/8/2001 | 8.42 | 8.05 |




## NOTES

1. REPORTED GROUNDWATER ELEVATION DATA FROM 2001 THROUGH 2006 FOUND IN THE PRESIDIO SEMI ANNUAL GROUNDWATER MONITORING REPORT 1ST AND 2ND QUARTERS 2006 (TREADWELL AND ROLLO, OCTOBER 2006)

2. ALL WATER LEVELS SHOWN IN NAVD 88- US SURVEY FEET, HAVE BEEN CONVERTED FROM PLLW TO BE CONSISTENT WITH TOPOGRAPHIC SURVEY DATA. CONVERSION: NAVD 88 = PLLW-0.37

3. THE DATE AND ASSOCIATED WATER LEVELS HIGHLIGHTED IN GREEN ARE THE LOW VALUES; DATE AND ASSOCIATED WATER LEVELS HIGHLIGHTED IN YELLOW ARE THE HIGH VALUES.

MACTEC

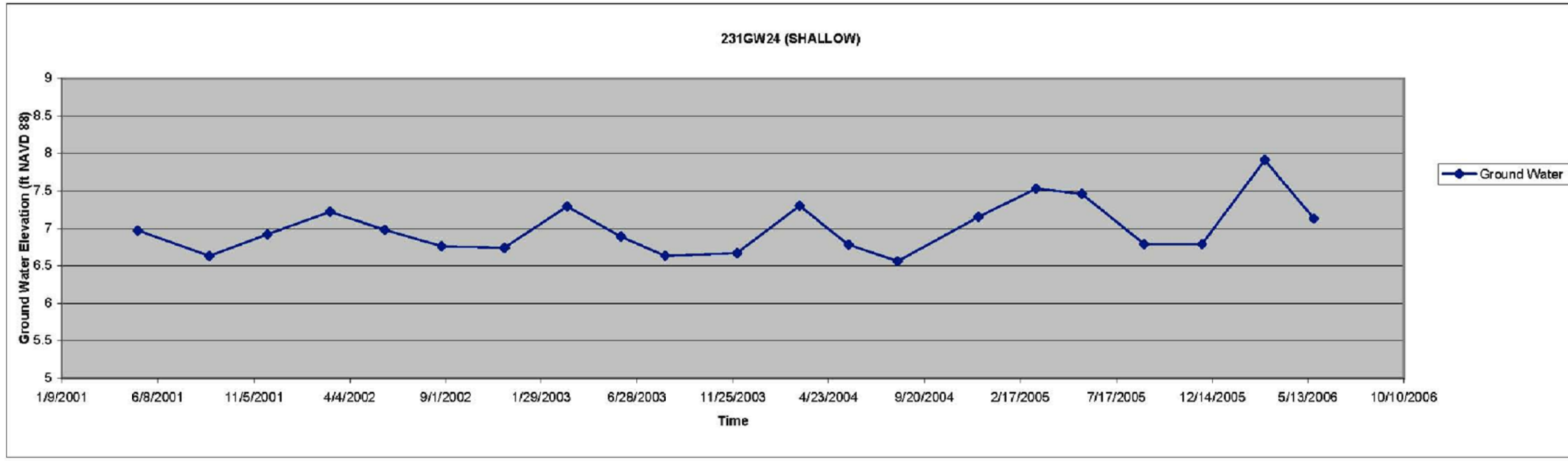
**HISTORICAL WATER LEVEL HYDROGRAPHS FOR SHALLOW ZONE AQUIFER WELLS 231GW19 / 231GW23**
BUILDING 207/231 AREA
PRESIDIO OF SAN FRANCISCO
SAN FRANCISCO, CALIFORNIA

FIGURE **J-7**

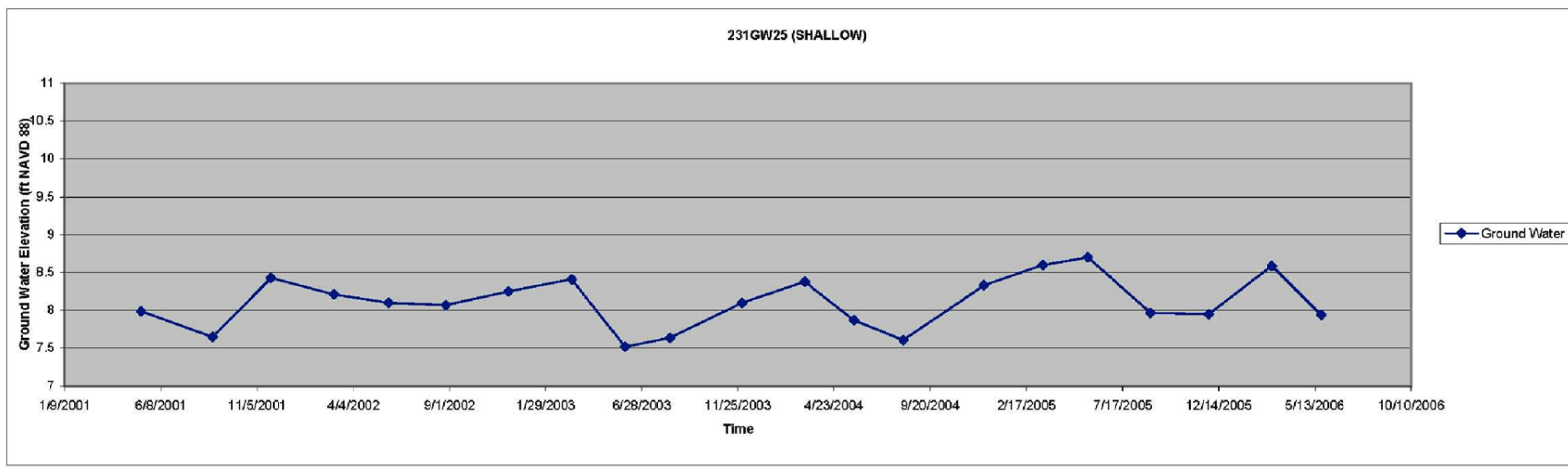
| DRAWN | JOB NUMBER | CHECKED | CHCK'D DATE | APPROVED | APPRV'D DATE |
|---|---|---|---|---|---|
| JHD | 4084075106 | JHD | 10/2008 | RR | 10/2008 |

4084075106073.DWG 40.0
20071019.1648

| 231GW24 | | |
|---|---|---|
| DATE | GW Elev. (feet PLLW) | GW Elev. (feet NAVD 88) |
| 5/22/2006 | 7.5 | 7.13 |
| 3/6/2006 | 8.28 | 7.91 |
| 11/28/2005 | 7.16 | 6.79 |
| 8/29/2005 | 7.16 | 6.79 |
| 5/23/2005 | 7.83 | 7.46 |
| 3/14/2005 | 7.9 | 7.53 |
| 12/13/2004 | 7.52 | 7.15 |
| 8/9/2004 | 6.93 | 6.56 |
| 5/24/2004 | 7.15 | 6.78 |
| 3/8/2004 | 7.67 | 7.3 |
| 12/1/2003 | 7.04 | 6.67 |
| 8/11/2003 | 7 | 6.63 |
| 6/2/2003 | 7.26 | 6.89 |
| 3/10/2003 | 7.66 | 7.29 |
| 12/2/2002 | 7.11 | 6.74 |
| 8/26/2002 | 7.13 | 6.76 |
| 5/28/2002 | 7.35 | 6.98 |
| 3/4/2002 | 7.59 | 7.22 |
| 11/26/2001 | 7.29 | 6.92 |
| 8/27/2001 | 7 | 6.63 |
| 5/8/2001 | 7.34 | 6.97 |




| 231GW25 | | |
|---|---|---|
| DATE | GW Elev. (feet PLLW) | GW Elev. (feet NAVD 88) |
| 5/22/2006 | 8.31 | 7.94 |
| 3/6/2006 | 8.96 | 8.59 |
| 11/28/2005 | 8.32 | 7.95 |
| 8/29/2005 | 8.34 | 7.97 |
| 5/23/2005 | 9.07 | 8.7 |
| 3/14/2005 | 8.97 | 8.6 |
| 12/13/2004 | 8.7 | 8.33 |
| 8/9/2004 | 7.98 | 7.61 |
| 5/24/2004 | 8.24 | 7.87 |
| 3/8/2004 | 8.75 | 8.38 |
| 12/1/2003 | 8.47 | 8.1 |
| 8/11/2003 | 8.01 | 7.64 |
| 6/2/2003 | 7.89 | 7.52 |
| 3/10/2003 | 8.78 | 8.41 |
| 12/2/2002 | 8.62 | 8.25 |
| 8/26/2002 | 8.44 | 8.07 |
| 5/28/2002 | 8.47 | 8.1 |
| 3/4/2002 | 8.58 | 8.21 |
| 11/26/2001 | 8.8 | 8.43 |
| 8/27/2001 | 8.02 | 7.65 |
| 5/8/2001 | 8.36 | 7.99 |




## NOTES

1. REPORTED GROUNDWATER ELEVATION DATA FROM 2001 THROUGH 2006 FOUND IN THE PRESIDIO SEMI ANNUAL GROUNDWATER MONITORING REPORT 1ST AND 2ND QUARTERS 2006 (TREADWELL AND ROLLO, OCTOBER 2006)

2. ALL WATER LEVELS SHOWN IN NAVD 88- US SURVEY FEET, HAVE BEEN CONVERTED FROM PLLW TO BE CONSISTENT WITH TOPOGRAPHIC SURVEY DATA. CONVERSION: NAVD 88 = PLLW-0.37

3. THE DATE AND ASSOCIATED WATER LEVELS HIGHLIGHTED IN GREEN ARE THE LOW VALUES; DATE AND ASSOCIATED WATER LEVELS HIGHLIGHTED IN YELLOW ARE THE HIGH VALUES.

MACTEC

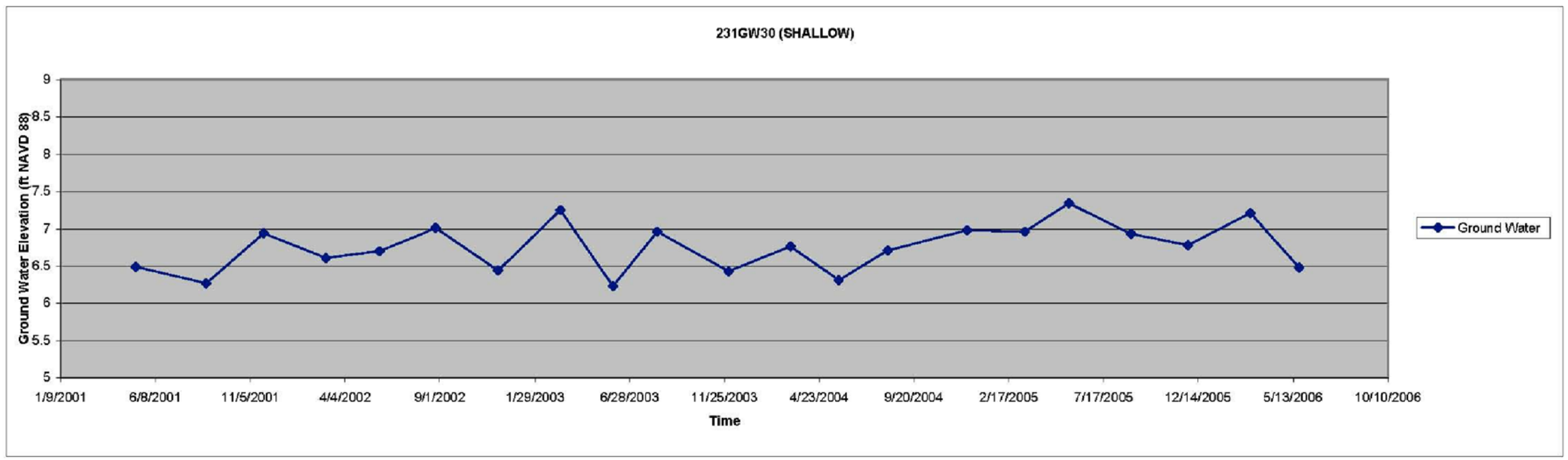
**HISTORICAL WATER LEVEL HYDROGRAPHS FOR SHALLOW ZONE AQUIFER WELLS: 231GW24 / 231GW25**
BUILDING 207/231 AREA
PRESIDIO OF SAN FRANCISCO
SAN FRANCISCO, CALIFORNIA

FIGURE
**J-8**

| DRAWN | JOB NUMBER | CHECKED | CHCK'D DATE | APPROVED | APPRV'D DATE |
|---|---|---|---|---|---|
| JHD | 4084075106 | JHD | 10/2008 | RR | 10/2008 |

4084075106073.DWG 40.0
20071019.1648

| 231GW30 | | |
|---|---|---|
| DATE | GW Elev. (feet PLLW) | GW Elev. (feet NAVD 88) |
| 5/22/2006 | 6.85 | 6.48 |
| 3/6/2006 | 7.58 | 7.21 |
| 11/28/2005 | 7.15 | 6.78 |
| 8/29/2005 | 7.3 | 6.93 |
| 5/23/2005 | 7.71 | 7.34 |
| 3/14/2005 | 7.33 | 6.96 |
| 12/13/2004 | 7.35 | 6.98 |
| 8/9/2004 | 7.08 | 6.71 |
| 5/24/2004 | 6.68 | 6.31 |
| 3/8/2004 | 7.13 | 6.76 |
| 12/1/2003 | 6.8 | 6.43 |
| 8/11/2003 | 7.33 | 6.96 |
| 6/2/2003 | 6.6 | 6.23 |
| 3/10/2003 | 7.62 | 7.25 |
| 12/2/2002 | 6.81 | 6.44 |
| 8/26/2002 | 7.38 | 7.01 |
| 5/28/2002 | 7.07 | 6.7 |
| 3/4/2002 | 6.98 | 6.61 |
| 11/26/2001 | 7.31 | 6.94 |
| 8/27/2001 | 6.64 | 6.27 |
| 5/8/2001 | 6.86 | 6.49 |




## NOTES

1. REPORTED GROUNDWATER ELEVATION DATA FROM 2001 THROUGH 2006 FOUND IN THE PRESIDIO SEMI ANNUAL GROUNDWATER MONITORING REPORT 1ST AND 2ND QUARTERS 2006 (TREADWELL AND ROLLO, OCTOBER 2006)

2. ALL WATER LEVELS SHOWN IN NAVD 88- US SURVEY FEET, HAVE BEEN CONVERTED FROM PLLW TO BE CONSISTENT WITH TOPOGRAPHIC SURVEY DATA. CONVERSION: NAVD 88 = PLLW-0.37

3. THE DATE AND ASSOCIATED WATER LEVELS HIGHLIGHTED IN GREEN ARE THE LOW VALUES; DATE AND ASSOCIATED WATER LEVELS HIGHLIGHTED IN YELLOW ARE THE HIGH VALUES.

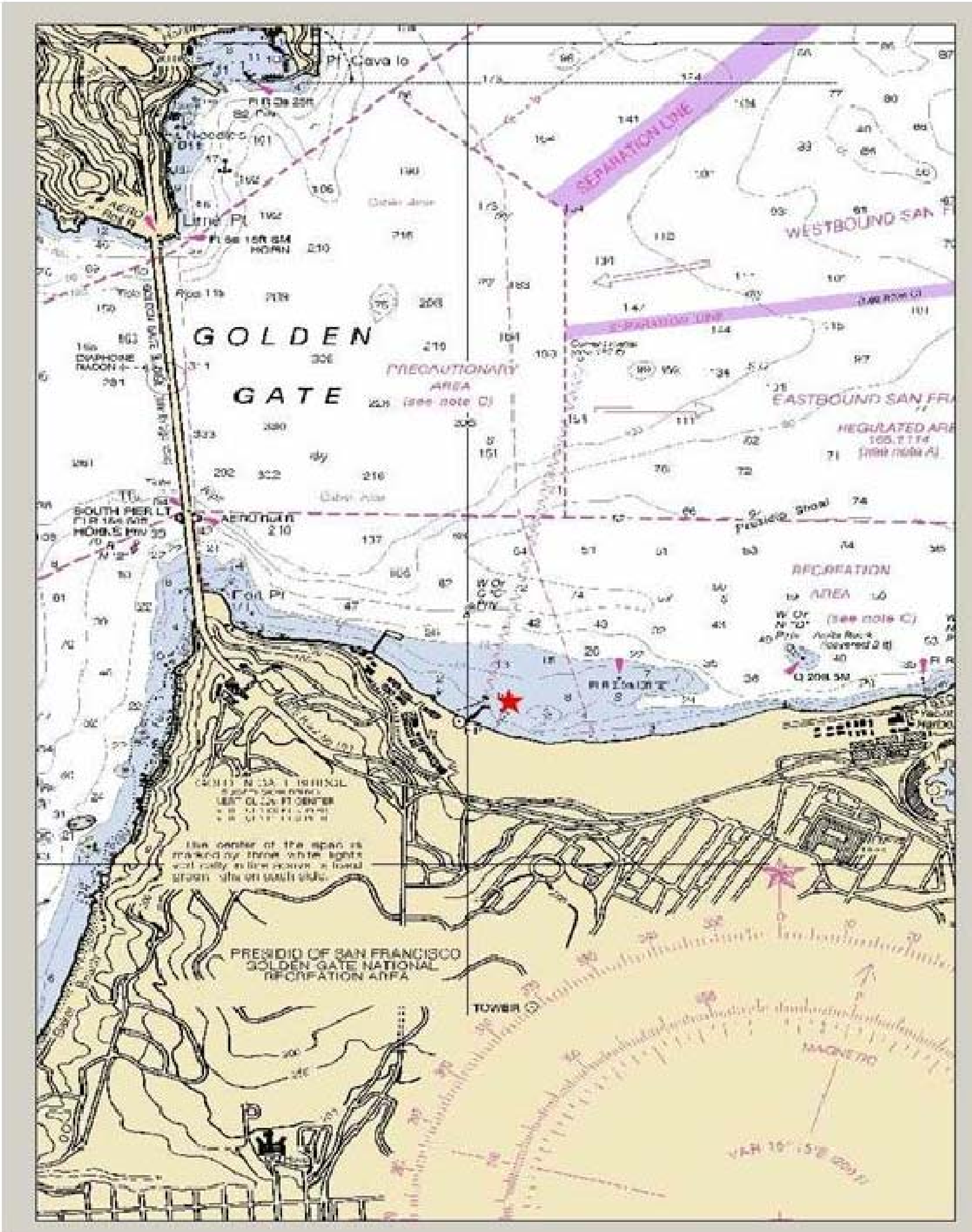
MACTEC

**HISTORICAL WATER LEVEL HYDROGRAPHS FOR SHALLOW ZONE AQUIFER WELLS: 231GW30**
BUILDING 207/231 AREA
PRESIDIO OF SAN FRANCISCO
SAN FRANCISCO, CALIFORNIA

FIGURE
**J-9**

| DRAWN | JOB NUMBER | CHECKED | CHCK'D DATE | APPROVED | APPRV'D DATE |
|---|---|---|---|---|---|
| JHD | 4084075106 | JHD | 10/2008 | RR | 10/2008 |

4084075106073.DWG 40.0
20071019.1648




**LEGEND**

★ TIDE STATION 9414290

**NOTES:**

1. TIDE DATA SOURCE; TIDE GAGE STATION #9414290 (NORTH EAST SIDE OF NPS WHARF) NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION WEB SITE. http://co-ops.nos.noaa.gov/station_info.shtml?stn=9414290%20San%20Francisco,%20CA

NOT TO SCALE

MACTEC

**TIDE STATION LOCATION MAP**
**FOR SAN FRANCISCO BAY**
BUILDING 207/231 AREA
PRESIDIO OF SAN FRANCISCO
SAN FRANCISCO, CALIFORNIA

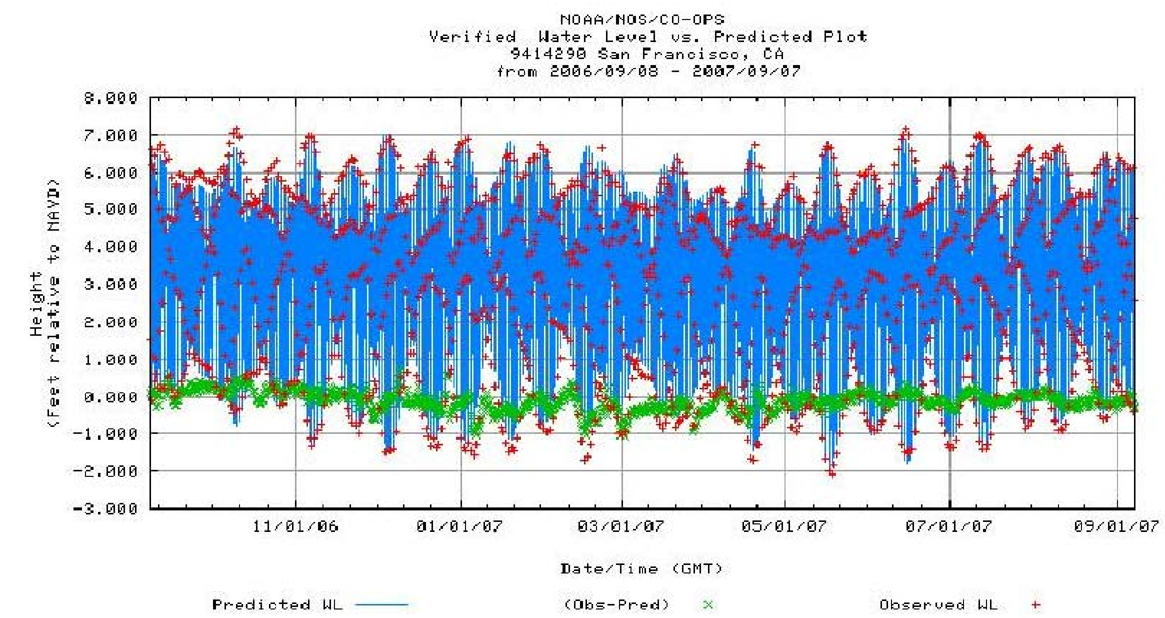
FIGURE
**J-10**

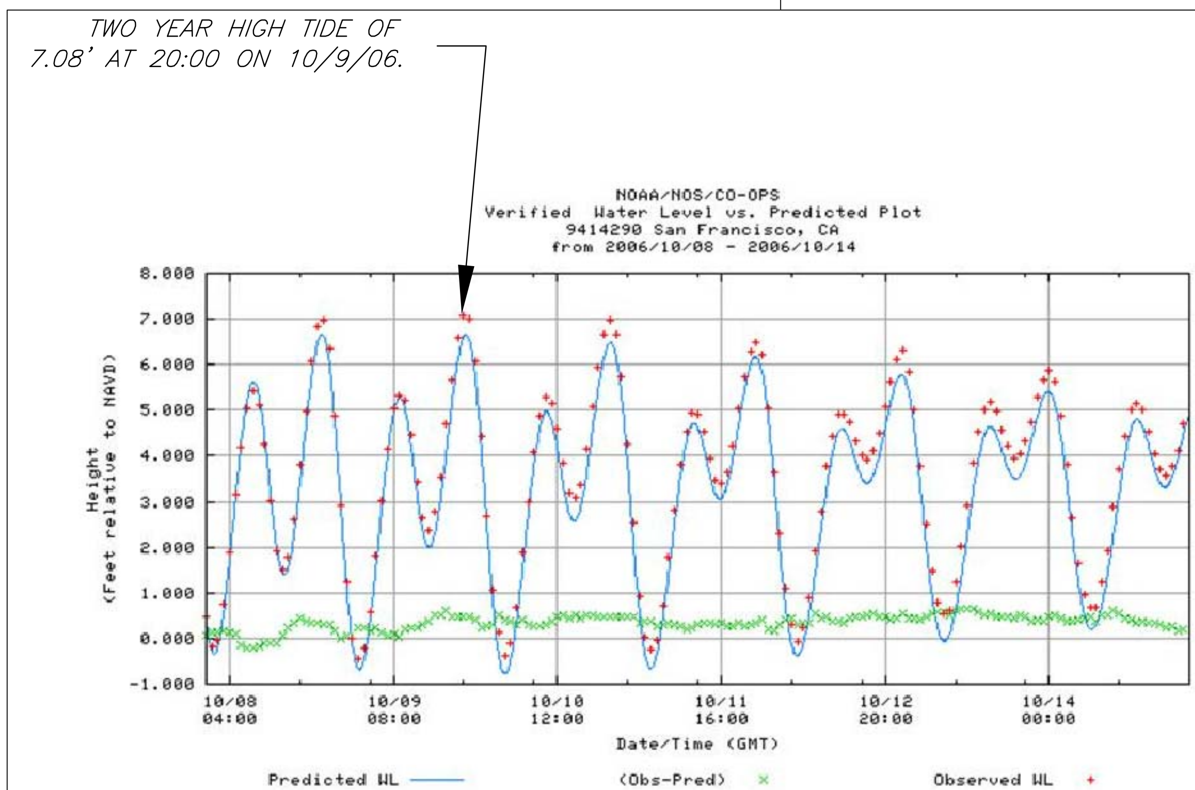
| DRAWN | JOB NUMBER | CHECKED | CHCK'D DATE | APPROVED | APPRV'D DATE |
|---|---|---|---|---|---|
| JHD | 4084075106 | JHD | 10/2008 | RR | 10/2008 |

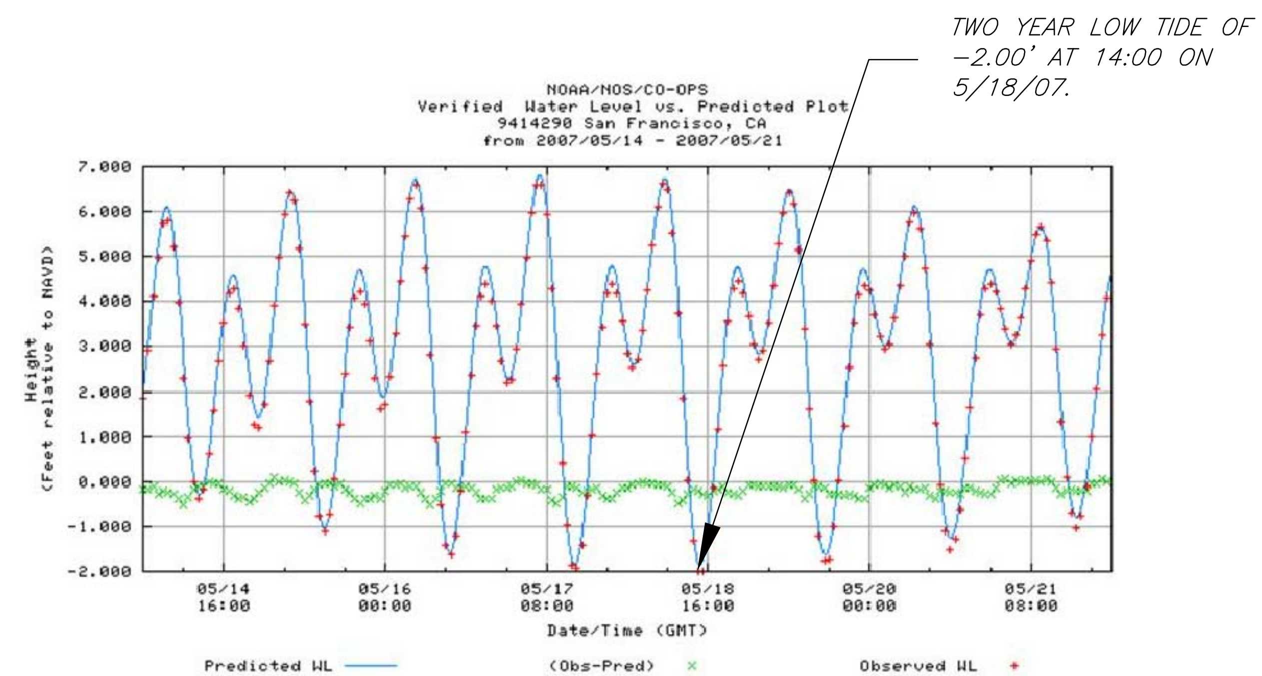
4084075106073.DWG 40.0
20071019.1648

**NOTES:**

1. HIGH AND LOW TIDE ELEVATION DATA FROM 2006-2007, SOURCE; TIDE GAGE STATION #9414290(NORTH EAST SIDE OF NPS WHARF) NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION WEB SITE. http://co-ops.nos.noaa.gov/data_menu.shtml?stn=9414290%20San%20Francisco,%20CA&type=Historic+Tide+Data




MACTEC

**TIDE LEVELS IN THE SAN FRANCISCO BAY**
**STATION 9414290**
BUILDING 207/231 AREA
PRESIDIO OF SAN FRANCISCO
SAN FRANCISCO, CALIFORNIA

FIGURE **J-11**

| DRAWN | JOB NUMBER | CHECKED | CHCK'D DATE | APPROVED | APPRV'D DATE |
|---|---|---|---|---|---|
| JHD | 4084075106 | JHD | 10/2008 | RR | 10/2008 |

4084075106073.DWG 40.0
20071019.1648

ATTACHMENT J1

SEWAGE EJECTOR PUMP TECHNICAL SPECIFICATIONS

REVIEWED: RR

# HYDROMATIC®

# SKV40

## Submersible Sewage Ejector Pump

Available

- Manual Operation
- Automatic Operation
- Wide Angle (shown)

CSA


HYDROMATIC SUPPORTS THE PROFESSIONAL

**HYDROMATIC**®
**Pentair Pump Group**

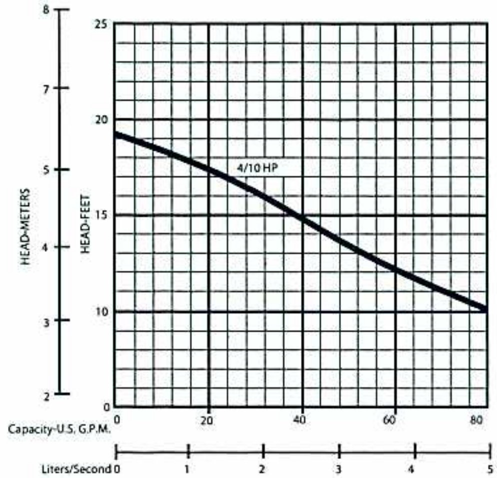
# SKV40 - Submersible Sewage Ejector Pump

## Details

### Pump Characteristics

| | | |
|---|---|---|
| Pump/Motor Unit | Submersible | |
| Manual Models | SKV40M1 | SKV40M2 |
| Automatic Models | SKV40A1 | SKV40A2 |
| Horsepower | 4/10 | |
| Full Load Amps | 12.6 | 6.4 |
| Motor Type | Shaded Pole (4 Pole) | |
| R.P.M. | 1550 | |
| Phase Ø | 1 | |
| Voltage | 115 | 230 |
| Hertz | 60 | |
| Operation | Intermittent | |
| Temperature | 120°F Ambient | |
| NEMA Design | A | |
| Insulation | Class A | |
| Discharge Size | 2" NPT std. | |
| Solids Handling | 2" | |
| Unit Weight | 35 lbs. | |
| Power Cord | 18/3, SJTW, 10' std. (20' opt.) 230V = 10' std. | |

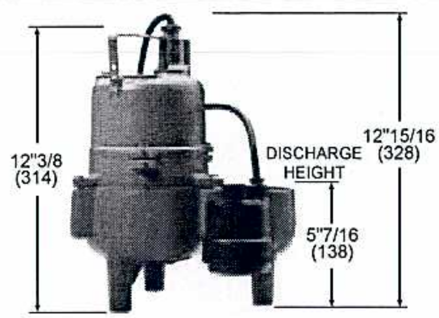
### Performance Data




### Materials of Construction

| | |
|---|---|
| Handle | Steel |
| Lubricating Oil | Dielectric Oil |
| Motor Housing | Cast Iron |
| Seal Plate | Cast Iron |
| Pump Casing | Cast Iron |
| Shaft | Stainless Steel |
| Mechanical Shaft Seal | Seal Faces: Carbon/Ceramic<br>Seal Body: Anodized Steel<br>Spring: Stainless Steel<br>Bellows: Buna-N |
| Impeller | Engineered Thermoplastic |
| Upper Bearing | Brass Sleeve Bearing |
| Lower Bearing | Single Row Ball Bearing |
| Fasteners | Stainless Steel |

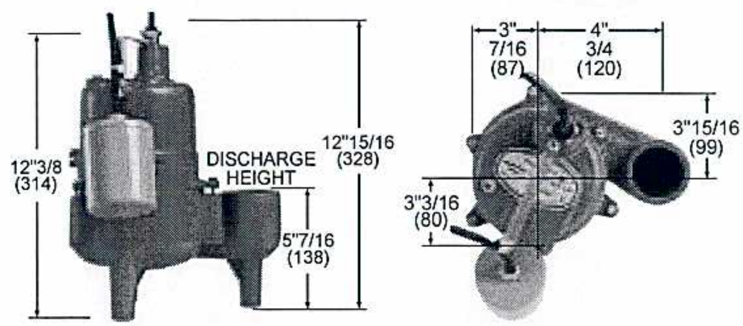
### Dimensional Data




Diaphragm Switch
On = 8-7/8
Off = 4-1/4

Vertical Switch
On = 8-15/16
Off = 4-7/16

Wide Angle Switch
On = 12-1/2
Off = 6-1/2




All dimensions in inches. Metric for international use. Component dimensions may vary ± 1/8 inch. Dimensional data not for construction purpose unless certified. Dimensions and weights are approximate. On/Off level adjustable. We reserve the right to make revisions to our product and their specifications without notice.

**HYDROMATIC®**
**Pentair Pump Group**

– Your Authorized Local Distributor –


USA
1840 Baney Road Ashland, Ohio 44805
Tel: 419-289-3042 Fax: 419-281-4087

www.hydromatic.com

CANADA
269 Trillium Drive Kitchener, Ontario, Canada N2G 4W5
Tel: 519-896-2163 Fax: 519-896-6337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Item #: W-02-6730 4/01 5M

ATTACHMENT J2

COSTS DIFFERENTIAL TO RAISE GRADE TO HISTORIC HIGH GROUNDWATER ELEVATIONS

REVIEWED: RR

MACTEC

MACTEC Engineering and Consulting, Inc.
5341 Old Redwood Highway, Suite 300
Petaluma, CA 94954

JOB NO. 4084075106 SHEET 1 OF 1
PHASE ____ TASK 02
JOB NAME 207/231 RESTORATION
BY J. Hanzel-Durbin DATE 10/12/07
CHECKED BY Ram Rao DATE 10/12/07

Costs ~~between~~ ~~[illegible]~~ Differential to raise to historic high elevations:

The difference in options is a 1ft elevation change to the 27,900 $ft^2$ low area of the site.

$27,900\ ft^2 \cdot 1ft = 27,900\ ft^3$

$= 1033\ yd^3$

@ $1.21\ ton/yd^3$

$= 1250$ tons

@ \$35/ton

Cost = \$43761.00

or

$\approx$ \$44,000

ATTACHMENT J3

PRECIPITATION FREQUENCY DATA OUTPUT, BLDG 207/231 AREA

REVIEWED: RR

**<u>Precipitation Frequency Data Output, Bldg 207/231 Area</u>**
**NOAA Atlas 2**
**California 37.8 N 122.45 W**
***Site-specific Estimates***

---

| Map | Precipitation (inches) | Precipitation Intensity (in/hr) |
|---|---|---|
| 2-year 6-hour | 1.32 | 0.22 |
| 2-year 24-hour | 2.32 | 0.10 |
| 100-year 6-hour | 2.47 | 0.41 |
| 100-year 24-hour | 4.94 | 0.21 |
| | | |

---

Hydrometeorological Design Studies Center - NOAA/National Weather Service
1325 East-West Highway - Silver Spring, MD 20910 - (301) 713-1669

Wed Oct 3 14:50:49 2007

ATTACHMENT J4

CALCULATIONS FOR STORM WATER DRAINAGE FOR BLDG 207/231 AREA

REVIEWED: RR

**MACTEC**

MACTEC Engineering and Consulting, Inc.
5341 Old Redwood Highway, Suite 300
Petaluma, CA 94954

JOB NO. 408 4075106 SHEET 1 OF 2
PHASE TASK 02
JOB NAME 207/234 Restoration
BY J. Hamel-Dubin DATE 10/12/07
CHECKED BY Ram Rao DATE 10/12/07

Water drainage from Restoration Area:

Objective: ① Determine Rainfall in Restoration area that will accumulate during 5hr high tide.
② Determine if 12" HDPE SD pipe @ a .5% slope will be adequate.
③ Check worst case senerio time to drain the site durring a high groundwater event & large storm.

note: Restoration Low Area = 27,900 ft²

① From NOAA website 100yr 6hr storm intensity = .41 in/hr
Assume: - Soil is 100% saturated with GW so runoff coefficient = 1.00
- High tide will last 5hr

$V_{\text{quantity of water}} = (.41\,in/hr)(ft/12in)(27,900\,ft^2)(5hr)$

$V = \underline{4766\,ft^3}$

This is amount of water that will Accumulate durring the 5hr high tide when there is a large storm (100yr, 6hr)

Note: 5hr tide was found from real time data & is maximum time the tide is above 5ft. Storm Drain connects to 72" SD approximately just above 5ft and should be able to begin draining site once tide falls below 5ft

② 12" HDPE SD pipe @0.5% slope

$V = \frac{1.486}{n}(R^{2/3})(S^{1/2})$

Assume: n = mannings roughness coef. = 0.009 for PVC
S = Slope = .005
R = hydraulic Radius = A/Per = 12/24 = .25

$V = \frac{1.486}{.009}(.25^{2/3})(.005^{1/2})$

$= \underline{4.63\,ft/s} > 2.5\,ft/s$ (PE textbook suggest to be above 2.5 ft/s)

Good

Reference: Formulas & constants were found in "Civil Engineering Reference Manual for PE Exam", 10th edition. Michael R. Lindeburg P.E.

**MACTEC**

MACTEC Engineering and Consulting, Inc.
5341 Old Redwood Highway, Suite 300
Petaluma, CA 94954

JOB NO. 40840 75106 SHEET 2 OF 2
PHASE ___ TASK 02
JOB NAME 207/231 RESTORATION
BY J. Hanzel-Durbin DATE 10/12/07
CHECKED BY Ram Rao DATE 10/12/07

(3) Worst Case Scenerio where 5hr high tide occurs during 100 yr - 6hr storm at a time where GW levels are at a peak 1ft above ground surface.

Question: how long will it take to drain.

- Determine Flow (Q) through SD pipe

$Q = AV$
$= (.785)(4.63)$
$= 3.63 ft^3/s$

$A = \pi r^2$
$= \pi (6/12)^2$
$= .785$

$Q = 3.63 ft^3/s$ = Flow of water leaving site once tide drops

- Determine Flow comeing onto the site during storm

$Q = .41 in/hr (ft/12in)(27,900 ft^2) = 953.25 ft^3/hr \left(\frac{hr}{60 min}\right)\left(\frac{min}{60 sec}\right)$
$= .265 ft^3/sec$

- Flow leaveing site

$Q_{in} = .265 ft^3/sec$
$Q_{out} = 3.63 ft^3/sec$

$Flow_{out} = Q_{out} - Q_{in} = \underline{3.36 ft^3/sec}$

- Time to remove water from site:

$T = Vol_{collected} / Flow_{out}$

$V_{collected} = V_{quantity\ of\ rainfall\ collected} + V_{Groundwater}$

$V_{ground\ water} = 27,900 ft^2 \cdot 1 ft = 27,900 ft^3$

$V_{quantity\ of\ rainfall\ collected}$ (from (1)) $= 4766 ft^3$

$T = \frac{27,900 + 4766}{3.36} = 9722 sec = \underline{\underline{2.7 \text{ hours}}}$

good #

ATTACHMENT J5

BACKUP ASSUMPTIONS FOR HYDRAULIC CAPACITY ESTIMATION
OF NEW 12-INCH STORM DRAIN LINE

REVIEWED: RR

CIVIL ENGINEERING REFERENCE MANUAL,
MICHAEL LINDBURG



## APPENDIX 18.B *(continued)*
### Properties of Saturated Steam by Temperature

| | | specific volume ($ft^3/lbm$) | | internal energy (Btu/lbm) | | enthalpy (Btu/lbm) | | | entropy (Btu/lbm-°R) | |
|---|---|---|---|---|---|---|---|---|---|---|
| temp. (°F) | absolute pressure | sat. liquid ($v_f$) | sat. vapor ($v_g$) | sat. liquid ($u_f$) | sat. vapor ($u_g$) | sat. liquid ($h_f$) | evap. ($h_{fg}$) | sat. vapor ($h_g$) | sat. liquid ($s_f$) | sat. vapor ($s_g$) |
| 300 | 67.01 | 0.01745 | 6.466 | 269.5 | 1099.8 | 269.7 | 910.3 | 1180.0 | 0.4372 | 1.6351 |
| 310 | 77.69 | 0.01755 | 5.626 | 279.8 | 1101.9 | 280.1 | 902.8 | 1182.8 | 0.4507 | 1.6236 |
| 320 | 89.67 | 0.01765 | 4.914 | 290.1 | 1103.9 | 290.4 | 895.1 | 1185.5 | 0.4640 | 1.6120 |
| 330 | 103.07 | 0.01776 | 4.308 | 300.5 | 1105.9 | 300.8 | 887.2 | 1188.0 | 0.4772 | 1.6007 |
| 340 | 118.02 | 0.01787 | 3.788 | 310.9 | 1107.7 | 311.2 | 879.3 | 1190.5 | 0.4902 | 1.5897 |
| 350 | 134.63 | 0.01799 | 3.343 | 321.3 | 1109.4 | 321.7 | 871.0 | 1192.7 | 0.5032 | 1.5789 |
| 360 | 153.03 | 0.01811 | 2.958 | 331.8 | 1111.0 | 332.3 | 862.5 | 1194.8 | 0.5161 | 1.5684 |
| 370 | 173.36 | 0.01823 | 2.625 | 342.3 | 1112.5 | 342.9 | 853.8 | 1196.7 | 0.5289 | 1.5580 |
| 380 | 195.71 | 0.01836 | 2.336 | 352.9 | 1113.9 | 353.5 | 845.0 | 1198.5 | 0.5415 | 1.5478 |
| 390 | 220.3 | 0.01850 | 2.084 | 363.5 | 1115.1 | 364.3 | 835.8 | 1200.1 | 0.5541 | 1.5378 |
| 400 | 247.3 | 0.01864 | 1.864 | 374.2 | 1116.2 | 375.1 | 826.4 | 1201.4 | 0.5667 | 1.5279 |
| 410 | 276.7 | 0.01878 | 1.671 | 385.0 | 1117.1 | 385.9 | 816.7 | 1202.6 | 0.5791 | 1.5182 |
| 420 | 308.8 | 0.01894 | 1.501 | 395.8 | 1117.8 | 396.9 | 806.6 | 1203.6 | 0.5915 | 1.5085 |
| 430 | 343.6 | 0.01910 | 1.351 | 406.7 | 1118.4 | 407.9 | 796.4 | 1204.3 | 0.6038 | 1.4990 |
| 440 | 381.5 | 0.01926 | 1.218 | 417.6 | 1118.9 | 419.0 | 785.8 | 1204.8 | 0.6161 | 1.4895 |
| 450 | 422.5 | 0.01944 | 1.0999 | 428.7 | 1119.1 | 430.2 | 774.9 | 1205.1 | 0.6283 | 1.4802 |
| 460 | 466.8 | 0.01962 | 0.9951 | 439.8 | 1119.2 | 441.5 | 763.6 | 1205.1 | 0.6405 | 1.4708 |
| 470 | 514.5 | 0.01981 | 0.9015 | 451.1 | 1119.0 | 452.9 | 752.0 | 1204.9 | 0.6527 | 1.4615 |
| 480 | 566.0 | 0.02001 | 0.8179 | 462.4 | 1118.7 | 464.5 | 739.8 | 1204.3 | 0.6648 | 1.4522 |
| 490 | 621.2 | 0.02022 | 0.7429 | 473.8 | 1118.1 | 476.1 | 727.4 | 1203.5 | 0.6769 | 1.4428 |
| 500 | 680.6 | 0.02044 | 0.6756 | 485.4 | 1117.2 | 487.9 | 714.4 | 1202.3 | 0.6891 | 1.4335 |
| 520 | 812.1 | 0.02092 | 0.5601 | 508.9 | 1114.6 | 512.0 | 686.9 | 1198.9 | 0.7134 | 1.4146 |
| 540 | 962.2 | 0.02146 | 0.4655 | 533.0 | 1111.1 | 536.8 | 657.2 | 1194.0 | 0.7378 | 1.3952 |
| 560 | 1132.7 | 0.02209 | 0.3874 | 557.8 | 1106.0 | 562.4 | 624.8 | 1187.2 | 0.7635 | 1.3753 |
| 580 | 1325.3 | 0.02279 | 0.3223 | 583.5 | 1099.2 | 589.1 | 589.2 | 1178.3 | 0.7876 | 1.3543 |
| 600 | 1542.5 | 0.02363 | 0.2674 | 610.3 | 1090.3 | 617.0 | 549.6 | 1166.6 | 0.8133 | 1.3320 |
| 620 | 1786.2 | 0.02465 | 0.2206 | 635.6 | 1075.6 | 646.7 | 504.8 | 1151.5 | 0.8401 | 1.3077 |
| 640 | 2059.2 | 0.02593 | 0.1802 | 668.9 | 1063.2 | 678.7 | 453.1 | 1131.8 | 0.8683 | 1.2803 |
| 660 | 2365 | 0.02766 | 0.1444 | 702.1 | 1042.2 | 714.5 | 390.8 | 1105.3 | 0.8991 | 1.2482 |
| 680 | 2707 | 0.03038 | 0.1113 | 742.2 | 1011.1 | 757.4 | 309.1 | 1066.5 | 0.9355 | 1.2070 |
| 700 | 3093 | 0.03665 | 0.0748 | 801.5 | 918.2 | 822.5 | 168.5 | 991.0 | 0.9900 | 1.1350 |
| 705.1028 | 3200.11 | 0.019746 | 0.019746 | 866.6 | 866.6 | 896.1 | 0 | 896.1 | 1.0530 | 1.0530 |
| 32.018 | 0.08871 | 0.01602 | 3300 | 0.0 | 1021.0 | 0.000263 | 1075 | 1075.2 | 0 | 2.1863 |





## APPENDIX 19.A
### Manning's Roughness Coefficient[a,b]
(design use)

| channel material | n |
|---|---|
| plastic (PVC and ABS) | 0.009 PE/PVC Pipe . |
| clean, uncoated cast iron | 0.013-0.015 |
| clean, coated cast iron | 0.012-0.014 |
| dirty, tuberculated cast iron | 0.015-0.035 |
| riveted steel | 0.015-0.017 |
| lock-bar and welded steel pipe | 0.012-0.013 |
| galvanized iron | 0.015-0.017 |
| brass and glass | 0.009-0.013 |
| wood stave | |
| small diameter | 0.011-0.012 |
| large diameter | 0.012-0.013 |
| concrete | |
| average value used | 0.013 . |
| typical commercial, ball and spigot rubber gasketed end connections | |
| full (pressurized and wet) | 0.010 |
| – partially full | 0.0085 |
| with rough joints | 0.016-0.017 |
| dry mix, rough forms | 0.015-0.016 |
| wet mix, steel forms | 0.012-0.014 |
| very smooth, finished | 0.011-0.012 |
| vitrified sewer | 0.013-0.015 |
| common-clay drainage tile | 0.012-0.014 |
| asbestos | 0.011 |
| planed timber (flume) | 0.012 (0.010-0.014) |
| canvas | 0.012 |
| unplaned timber (flume) | 0.013 (0.011-0.015) |
| brick | 0.016 |
| rubble masonry | 0.017 |
| smooth earth | 0.018 |
| firm gravel | 0.023 |
| corrugated metal pipe (CMP) | 0.024 (see App. 17.F) |
| natural channels, good condition | 0.025 |
| rip rap | 0.035 |
| natural channels with stones and weeds | 0.035 |
| very poor natural channels | 0.060 |

[a]Compiled from various sources.
[b]Values outside these ranges have been observed, but these values are typical.

Support Material

APPENDIX K

GEOTECHNICAL RECOMMENDATIONS FOR EXCAVATION SETBACKS

REVIEWED BY: RR

**To:** File

**From:** P. Jared Mechetti
Donald W. Quigley, P.E., G.E.

**Date:** February 19, 2006; updated February 20, 2008

**Subject:** Stability Analyses of Historic Walls
During Excavation Activities
Building 207 / 231 Area
Presidio of San Francisco, California

**Project Number:** 4089041001.107; 4084075106.05

### Purpose of Slope Stability Analysis

This memorandum presents the results of analyses MACTEC performed to evaluate the stability of the two existing historic walls adjacent to the south and west sides of Building 231 (see Plate 1) during the planned excavation activities outlined in the Corrective Action Implementation Work Plan (CAIWP). The purpose of the analyses was to assess the stability of both historic walls during excavation and removal of contaminated soil adjacent to the wall.

### Material Properties

Soil profiles and material properties were developed based on a review of several monitoring well installation logs in the immediate vicinity of the planned work and on engineering judgment. Because no strength testing data for soil samples were available, we have made reasonable assumptions for soil strength parameters used in the stability analyses (including cohesion, internal angle of friction, and moist unit weight). The assumptions are presented on Plate 2, Stability Analysis. Because there are no construction drawings for the existing walls, we have assumed that they are founded at shallow depths below the ground surface in front of the walls.

### Geometric Properties

One cross-section (A-A') was selected for the stability analyses and is shown on the attached Site Map, Plate 1. The location of the cross-section was selected to model the steepest sections of the planned excavation and to utilize the maximum amount of available subsurface information. The depths of soil layers and depth to Bay Mud within the subsurface profile were estimated and interpolated from the existing logs and from the Geologic Cross Section, Plate 5 in the CAIWP. The assumed subsurface profiles are shown on Plate 2.

MACTEC
**MACTEC Engineering and Consulting, Inc.**
28 Second Street, Suite 700
San Francisco, CA 94105 - (415) 543-8422 FAX (415) 777-9706

**Circular Failure Surface Analyses**

The computer program Slope/W (Version 2004) by Geoslope International (*2004*) was used for the evaluation of circular failure surfaces (Spencer's Method). Slope/W uses limit equilibrium theory to compute the factor of safety (ratio of resisting forces to driving forces) for each of the several circular failure surfaces defined by the grid and radius method.

**Defining Stability**

Slope/W calculates a factor of safety, which is the ratio of the available resistance to sliding divided by the driving forces. The higher the factor of safety, the more stable the slope. Typically, a slope with a static factor of safety greater than 1.5 indicates a relatively stable slope. For short-term conditions, such as during construction, smaller factors of safety such as 1.3 are often acceptable, provided the soil conditions and strength properties are well known. Calculated factors of safety near 1.0 indicate that the slope may be on the verge of failure. Factors of safety well below 1.0 indicate that the slope analyzed would likely be unstable.

For large earthquake loads, slope stability methods often yield factors of safety less than 1.0, indicating slope "failure." However, the amount of downward and lateral slope movement during the earthquake will depend on the severity of the earthquake and the static factor of safety of the slope. In addition, slopes can fail or displace significantly if the soils are loose sands that liquefy during the earthquake.

**Results**

For our analysis, we assumed that the sides of the excavation will be sloped at a minimum of 1½:1 (horizontal to vertical) or flatter and that there will be a minimum of 3 feet between the top of the slope and the outer edge of the wall. Our stability analysis of Section A-A' indicates that during the planned excavation activities, the historic walls will have a static factor of safety slightly less than 1.5 for the conditions analyzed. We judge that a 5-foot setback would yield a factor of safety of 1.5 or greater.

We did not perform stability analyses of the planned excavation during a large earthquake because the risk of a large earthquake occurring during the short period of time that the excavation will be open is small. However, it should be noted that the potential for wall movement or failure during a major earthquake is relatively large even under existing conditions. This is particularly true if loose sand layers within or below the Bay Mud at the site were to liquefy during a strong earthquake.

**Recommendations**

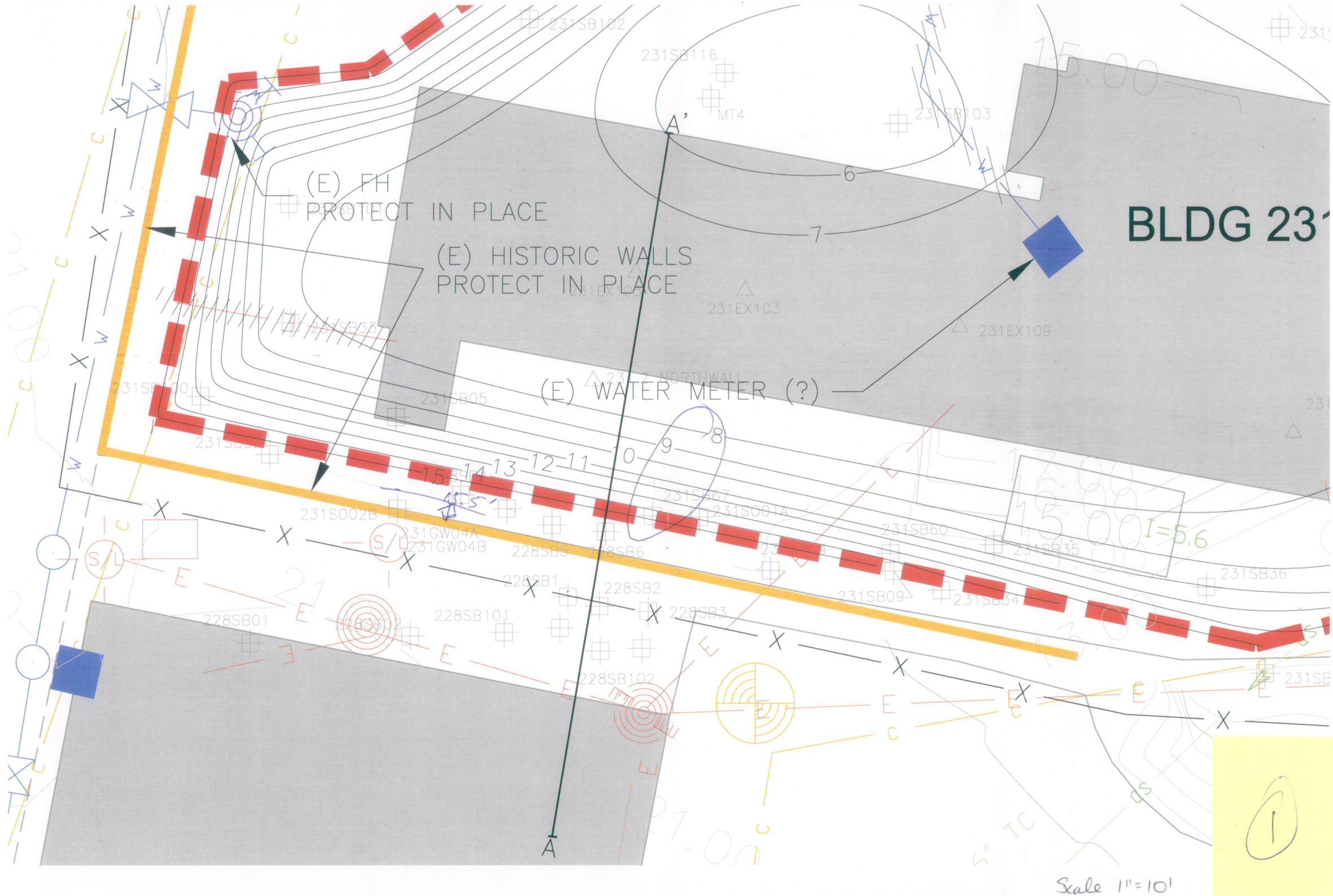
Our analyses indicate that the planned open-cut excavation can probably be made without impacting the stability of the historic walls. Because of the absence of strength data for the soils below and near the wall, we recommend that a minimum calculated factor of safety of 1.5 be maintained, i.e., corresponding to a setback of 5 feet from the wall to the top of the excavation slope.

We recommend that during construction, the contractor perform periodic surveys to monitor the walls for any signs of movement. We also recommend that a MACTEC Geologist monitor excavation activities that are within 20 feet of the historic walls to determine if soil conditions are consistent with those assumed from the monitoring well installation logs. If soil conditions differ from those reviewed in the

logs, adjustments of the excavation slopes may be necessary in the field to maintain stable conditions. However, the responsibility for maintaining stable excavation slopes and for preventing damage to the historic walls should be the contractor’s.

Attachments: Plate 1 - Site Map
Plate 2 - Stability Analysis

PJM/DWQ



(E) FH
PROTECT IN PLACE
(E) HISTORIC WALLS
PROTECT IN PLACE
(E) WATER METER (?)
BLDG 231
A'
A
231SB102
231SB116
MT4
231SB103
231EX103
231EX109
231SB05
231SO02B
231GW04A
231GW04B
228SB5
228SB6
228SB1
228SB2
228SB3
228SB01
228SB101
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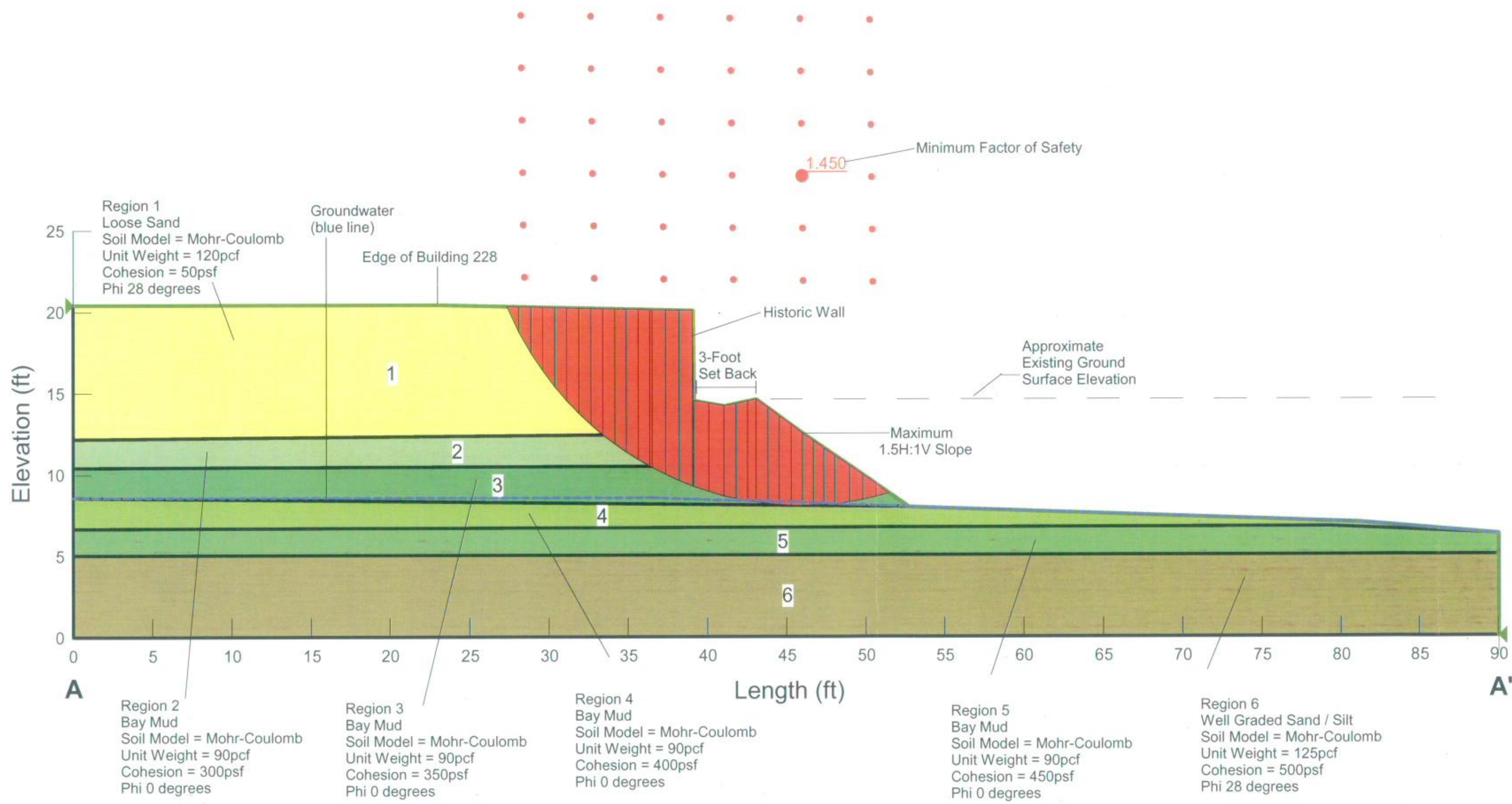
1
Scale 1"=10'




Slope Stability Analysis
PLATE
2